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AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA
Part 13. EUDICOTS: EUPHORBIACEAE – SPURGE FAMILY

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ABSTRACT

A floristic and natural history account is provided for the spurge family as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in the Sonoran Desert of southwestern Arizona. This contribution includes 31 species in 8 genera, all of which are native to the region except *Euphorbia prostrata* and perhaps *Euphorbia spathulata*. At least 9 species are represented in fossil record. *Euphorbia*, with 18 species, is the most diverse genus in the flora of southwest Arizona. *Euphorbia spathulata* is the only obligate cool-season ephemeral among the spurge family in the flora area and is not known elsewhere in the core area of the Sonoran Desert, and *Jatropha cinerea* is not known elsewhere in the USA.

This publication, encompassing the Euphorbiaceae, is our 13th contribution to the vascular plant flora in southwestern Arizona. The flora area covers 5141 km^2 (1985 mi^2) of contiguous protected areas in the heart of the Sonoran Desert (Fig. 1). This contribution also is available open access on Richard Felger's webpage on the website of the University of Arizona Herbarium (http://ag.arizona.edu/herbarium/people/rfelger).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Fossil specimens are indicated with a dagger symbol (†). The one non-native species of Euphorbiaceae is marked with an asterisk (*). In the following species accounts, the accepted scientific names are in bold and selected synonyms are italicized within brackets [--]. Common names, when known or worthwhile, are in English, Spanish, and the Hia-Ced O'odham dialect, respectively (see Felger 2007 and Felger et al. 1992 for usage of Hia-Ced O'odham plant names). Spanish-language names are italicized. The qualifications *about* and *approximately* are generally omitted, with the obvious understanding that many quantitative values in the descriptions are, to varying degrees, seldom exact.

All photos and scans are by Sue Rutman unless otherwise stated and botanical illustrations are by Lucretia Breazeale Hamilton (1908–1986), Matthew B. Johnson, and Marlo Buchmann. All specimens cited are at the University of Arizona Herbarium (ARIZ) unless otherwise indicated by the abbreviations for herbaria at Cabeza Prieta National Wildlife Refuge (CAB), Organ Pipe Cactus National Monument (ORPI), and the standardized abbreviations for herbaria (Index Herbariorum, Thiers 2014). We have seen specimens or images of all specimens cited. When no collection number is provided, the specimen is identified by the date of collection. Generally only the first collector's name is given. Area designations are: OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Additional explanation of the format for this flora series is provided in Part 3 (Felger et al. 2013b). Descriptions and keys pertain to taxa and populations as they occur in the flora area.

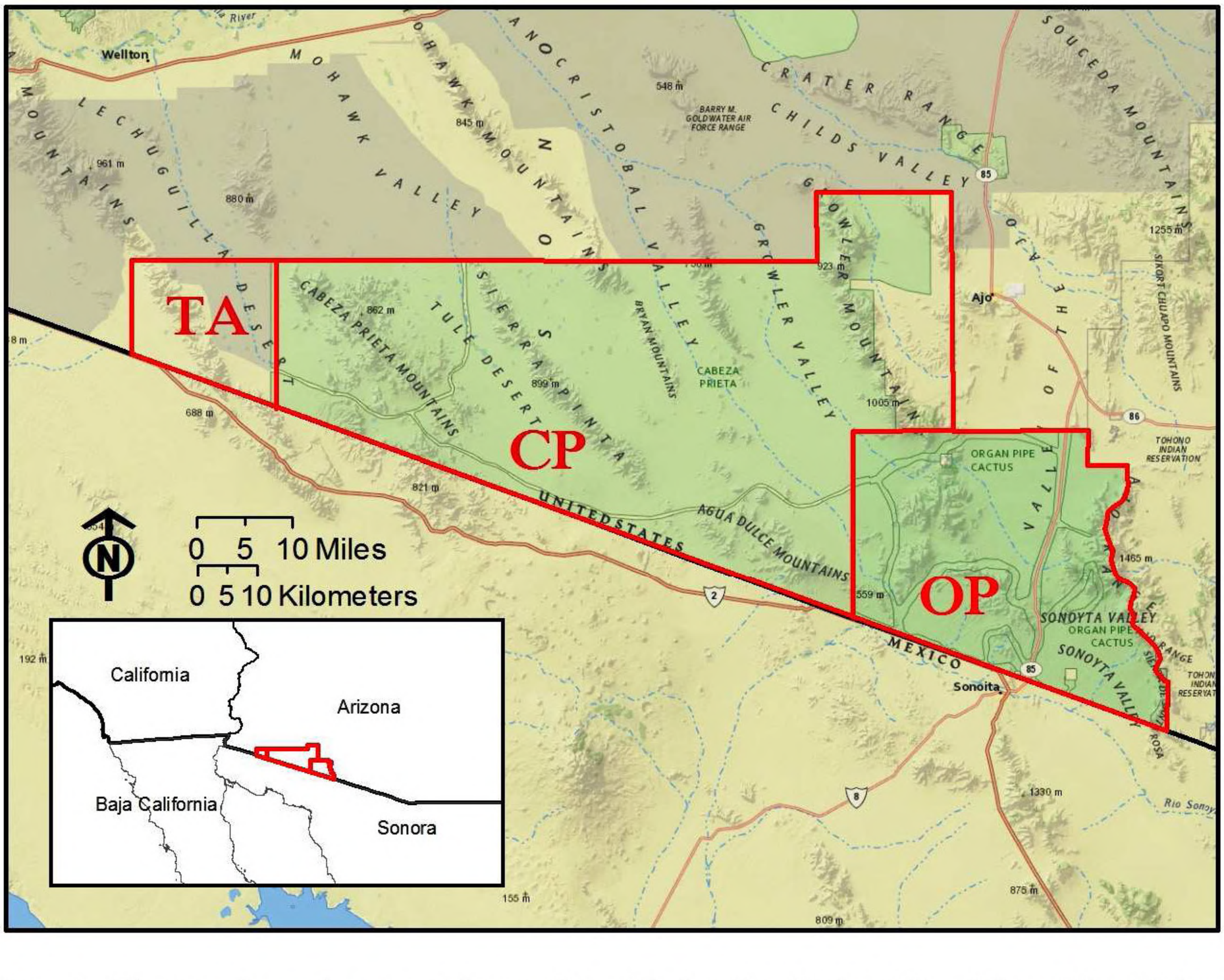

Figure 1. Flora area in southwestern Arizona. TA = Tinajas Altas Region; CP = Cabeza Prieta National Wildlife Refuge; OP = Organ Pipe Cactus National Monument. Green shading indicates approximate boundaries of federally designated wilderness.

EUPHORBIACEAE – Spurge Family

This large and diverse, mostly tropical and subtropical family is well represented in the Sonoran Desert. Plants of diverse habit, often with milky or watery sap. Leaves alternate, opposite or whorled (in some *Euphorbia*), simple (those in the flora area), mostly with stipules, although the stipules often small or quickly deciduous, or sometimes lacking. Inflorescences basically cymose but sometimes greatly reduced (as a cyathium in *Euphorbia*). Flowers unisexual; different flower parts often reduced, sometimes greatly so; perianth often inconspicuous, the tepals separate or united

below, or the petals or entire perianth absent. Ovary superior, mostly 3-chambered; styles usually 3, simple or branched. Fruits of capsules (those in the flora area), the segments (mericarps) usually 3 (or 1 or 2 by abortion). Seeds with or without a knob-like basal appendage (caruncle). Worldwide, 218 genera, 6745 species.

The spurge family in the flora area includes 31 species in 8 genera (Table 1). *Euphorbia*, with 18 species, is the most diverse genus in this flora. *Euphorbia prostrata* is the only species in the spurge family known to be non-native in the region, although *E. spathulata* may have been introduced in historic times. *Euphorbia spathulata* stands out as the only strictly cool-season ephemeral member of the family in the flora area and is not known elsewhere across most of the Sonoran Desert. *Jatropha cinerea* is not known elsewhere in the USA. At least 9 present-day species are also represented in the fossil record, documented from plant fragments recovered from packrat middens (see Felger et al. 2013a). The majority of species (83%) occur in Organ Pipe and only 26% are found in the hyperarid Tinajas Altas Region. Ten species are ephemerals and 5 are facultative annuals or perennials, together representing 48% of the total spurge flora. Seven species are shrubs: *Acalypha californica*, *Argythamnia brandegeei*, *Croton sonorae*, *Jatropha* with 3 species, and *Pleradenophora bilocularis*. The remaining perennials are herbaceous or subshrubs, and although they may flower in their first season, they are most often encountered as perennials. We have seen moderate to severe freeze damage on 8 perennials in the flora area: *Argythamnia brandegeei*, *A. lanceolata, Croton sonorae, C. wigginsii, Jatropha cinerea, J. cuneata, Stillingia linearifolia*, and *Pleradenophora bilocularis* (see Turner et al. 1995).

Table 1. Local distributions and growth forms of Euphorbiaceae in southwestern Arizona. † = Taxa also represented by fossil specimen(s); * = non-native species. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. SU = summer/warm-season ephemerals; WI = winter-spring/cool-season ephemerals; NS = non-seasonal ephemerals; AP = facultative annuals or perennials; PR = perennials.

Taxon	**Region**			**Growth Form**				
				Ephemerals			Perennials	
	Organ Pipe	Cabeza Prieta	Tinajas Altas	Summer	Winter	Non-seasonal	Facultative annual or perennial	Perennial
Acalypha californica	OP	CP						PR
Argythamnia adenophora	OP							PR
Argythamnia brandegeei		CP						PR
†*Argythamnia lanceolata*	OP	CP	TA					PR
†*Argythamnia serrata*	OP	CP	TA				AP	
†*Argythamnia* sp.			(TA)					
Croton sonorae	OP	CP						PR
Croton wigginsii		CP						PR
Euphorbia abramsiana	OP	CP	TA	SU				
Euphorbia albomarginata	OP	CP						PR
Euphorbia arizonica	OP							PR
Euphorbia capitellata	OP							PR
Euphorbia eriantha	OP	CP	TA			NS		
Euphorbia exstipulata	OP			SU				

Euphorbia florida	OP	CP		SU				
Euphorbia heterophylla	OP			SU				
†*Euphorbia hyssopifolia*	OP	CP		SU				
†*Euphorbia melanadenia*	OP							PR
Euphorbia micromera	OP	CP					AP	
Euphorbia pediculifera	OP	CP					AP	
Euphorbia platysperma			TA					PR
Euphorbia polycarpa	OP	CP	TA				AP	
**Euphorbia prostrata*	OP			SU				
Euphorbia setiloba	OP	CP	TA			NS		
Euphorbia spathulata		CP			WI			
Euphorbia trachysperma		CP		SU				
†*Euphorbia* sp./spp. (Hypericifoliae)	(OP)		(TA)					
†*Jatropha cardiophylla*	OP							PR
Jatropha cinerea	OP							PR
†*Jatropha cuneata*	OP	CP	TA					PR
†*Pleradenophora bilocularis*	OP	CP						PR
Stillingia linearifolia	OP	CP					AP	
†*Tragia* sp.	OP							PR
Totals	**26**	**20**	**8**	**6**	**1**	**2**	**5**	**16**
Percent of family in flora area	**84%**	**65%**	**26%**					
Percent of growth form in family				**19%**	**3%**	**6%**	**16%**	**55%**

1. Shrubs, or semi-shrubs, woody or not, often reaching 1 m or more in height.

2. Sap thick and conspicuously milky; leaves often with a pair of glands at the base of the blade ..... **Pleradenophora**

2. Sap watery or blood-like, or essentially absent, never milky.

3. Leaf margins with small, regularly spaced teeth (crenulate-toothed); styles multiple-branched with conspicuous red (rarely white), thread-like segments ..... **Acalypha**

3. Leaf margins entire, or with a few broad lobes, or minute teeth near the tip; styles entire or 2-branched (bifid).

4. Herbage, flowers, and fruits glabrous or with short, simple hairs; sap copious, watery or blood-like; leaves deltate, cuneate, or kidney-shaped to orbicular ..... **Jatropha**

4. Herbage, flowers, and fruits with 2-armed, stellate, or simple hairs; sap not copious, not as above; leaves lanceolate to elliptic.

5. Stems tough, not brittle, not semi-succulent; herbage and fruits with stellate hairs ..... **Croton**

5. Stems brittle and semi-succulent; young herbage and ovaries/fruits with 2-armed and coarse simple hairs, the mature herbage glabrate or sparsely pubescent ..... **Argythamnia brandegeei**

1. Annuals or perennial herbs, usually not woody, mostly less than 1 m tall.

6. Leaves alternate, opposite, or whorled; sap conspicuously milky; flowers in cyathia (small, head-like, compact inflorescences simulating a "normal" bisexual flower); sepals and petals none (white or pink petal-like appendages often extend from oval or round glands) ..... **Euphorbia**
6. Leaves alternate; sap not milky (or if milky then weakly so and rather watery in *Stillingia*) or essentially absent; flowers not in cyathia; sepals and petals variously present or absent.

7. Plants glabrous ..... **Stillingia**
7. Plants pubescent.

8. Stems slender and usually twining, the plants with stinging hairs ..... **Tragia**
8. Stems not twining, the hairs not stinging.

9. Plants with stellate hairs or stellate-lepidote scales ..... **Croton**
9. Plants with simple or 2-armed hairs (sometimes glabrate).

10. Plants usually glandular-viscid and sticky, with simple hairs (glandular and non-glandular); corollas (petals) none; stigmas red (rarely white) and conspicuous, each divided into multiple thread-like segments ..... **Acalypha**
10. Plants not glandular-viscid, the hairs 2-armed or simple, or plants sometimes largely glabrate; petals present, or sometimes essentially absent on male flowers; stigmas bifid (each stigma 2-branched), not red and not especially conspicuous ..... **Argythamnia**

Acalypha

Annuals to small trees; worldwide, mostly tropics and warm temperate region; 450 species (Levin, in press).

Acalypha californica Bentham
[*A. pringlei* S. Watson, see Levin 1995 and Levin & Gillespie in press]
California copperleaf; *hierba del cáncer*. Figure 2.

Shrubs mostly less than 1 m tall, sometimes to 1.5 m tall, with slender stems; sap essentially absent. Herbage viscid-sticky, with glandular and non-glandular simple hairs; young herbage densely pubescent; herbage becoming brownish during drought and plants eventually leafless in severe drought. Leaves alternate, petioled; leaf blades 1.5–5.5 cm long, ovate to cordate, the margins crenulate-toothed (the blades larger, thinner, greener, and less glandular when growing during warm weather and high soil moisture). Male and female flowers on the same plant, the flowers in axillary spikes. Flowers subtended by bracts; bracts of female flowers broad, toothed, markedly glandular, and enlarging with age. Calyces small; corollas none. Styles 3, the styles and stigmas 5–8 (9) mm long, red (rarely white), conspicuous, and divided into many thread-like segments. Fruits 3-seeded capsules. Seeds 2 mm long, obovoid, with a minute caruncle. Plants frost-sensitive, the aboveground herbage sometimes freeze-killed, and plants usually re-sprouting in spring. Flowering at various seasons, most luxuriantly with summer-fall rains.

Widely scattered: washes, canyons, and rocky slopes, the distribution largely limited by winter freezing. Widely scattered in Organ Pipe and probably in most or all mountain areas. Cabeza Prieta, especially in the eastern part and elsewhere in canyons in the larger mountains. Felger et al. (2012) list a specimen from Tinajas Altas (*Goodding 5 Dec 1935*), but we have not been able to locate the specimen and have not found any *Acalypha* specimens from Yuma County. The conspicuous multi-branched styles are unique among the spurge family in the flora area.

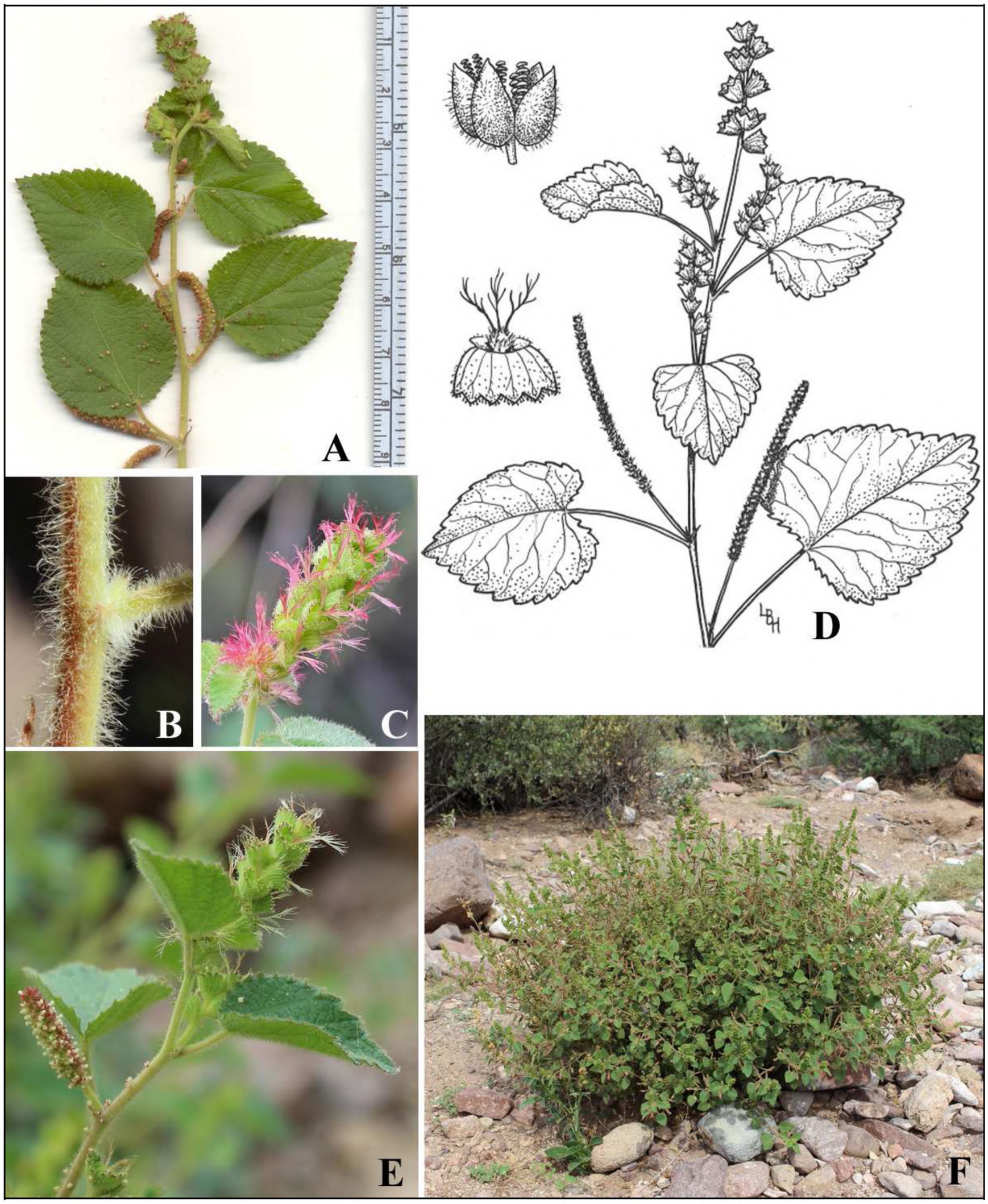

Figure 2. *Acalypha californica.* Alamo Canyon: (A) 10 Sep 2008; (B) 11 Mar 2014. (C, E & F) Estes Canyon near trailhead, 14 Aug 2013. (D) By Lucretia Breazeale Hamilton.

Northwestern Sinaloa to southwestern Arizona, and Baja California Sur to southern California.

OP: Canyon Diablo, 21 Mar 1935, *Peebles 10819*. Alamo Canyon, 12 Dec 1939, *Harbison 26237*. Bates Well, S slope, washes, scattered, small shrub, 12 Sep 1952, *Blakely B-1594* (DES, UCR). Estes Canyon, *Hesselberg 16 Oct 1966*. Twin Peaks, above residence area, 9 Sep 1984, *Van Devender 84-450*. Aguajita, 6 Apr 1988, *Felger 88-275*. Arch Canyon, 900 m, 2 Dec 1990, *Felger 90-545*. Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger 05-282*.

CP: Charlie Bell Pass road, 27 Sep 1992, *Harlan & Steinmann 347*. Little Tule Well, 18 Aug 1992, *Felger 92-649*.

Argythamnia – Silverbush

Annual or perennial herbs, subshrubs, or shrubs (elsewhere rarely small trees), with 2-armed hairs at least on ovaries and capsules and also with simple (unbranched) hairs (rarely glabrate or glabrous). The 2-armed (malpighiaceous) hairs are unique among the Euphorbiaceae in the Sonoran Desert; these hairs are often glassy, with the opposite arms lying close to the surface (appressed). Leaves alternate. Male and female flowers on the same plant (or perhaps sometimes on separate plants in *A. lanceolata*). Flowers axillary, usually in short racemes, the lower flowers in bisexual inflorescences female, the upper ones male. Female flowers conspicuously larger than the male flowers; sepals 5, petals 5. Male flowers with 5 glands opposite the sepals, petals present or absent, the stamens usually in 2 whorls of 5 each, the filaments united into a column (unique among members of the Euphorbiaceae in the flora area). Fruit a capsule splitting into three 1-seeded segments. Seeds without a caruncle (those in the flora area).

Argythamnia is a genus of 88 species in the Americas, mostly tropics, subtropics, and warm temperate regions with three subgenera including *Ditaxis* (Ramírez-Amezcua & Steinmann 2013). The Sonoran Desert taxa are in the subgenus *Ditaxis*, which includes about 50 species in the Americas, mostly in the tropics and subtropics, especially in arid and semi-arid regions. Subgenus *Ditaxis* has often been treated at the generic level.

1. Leaf margins with gland-tipped teeth……..…….…… **Argythamnia adenophora**
1. Leaf margins entire or the teeth not gland-tipped.

2. Plants spindly shrubs often more than 1 m tall; new growth and ovaries hairy, the rest of plant glabrous or sparsely hairy ……..…….... **Argythamnia brandegeei**
2. Plants less than 1 m tall, densely and coarsely hairy throughout (or plants growing in the shade and with ample soil may be only sparsely pubescent).

3. Herbaceous perennials to subshrubs; stems mostly erect and straight; male flowers with petals ……..…….... **Argythamnia lanceolata**
3. Plants herbaceous; stems mostly ascending to spreading, or sometimes the main axis at first erect but the branches spreading and seldom straight; male flowers without petals. ……**Argythamnia serrata**

Argythamnia adenophora A. Gray
[*Ditaxis adenophora* (A. Gray) Pax & K. Hoffmann]
Figure 3.

Herbaceous perennials, sometimes reproducing in the first season. Plants with simple hairs, except ovaries and capsules with 2-armed hairs. Leaf margins, stipules, and female sepals bear numerous, conspicuous, and relatively large tack-shaped glands; leaf blades elliptic to obovate, mostly 1–5 cm long. Male and female flowers occur on the same plant.

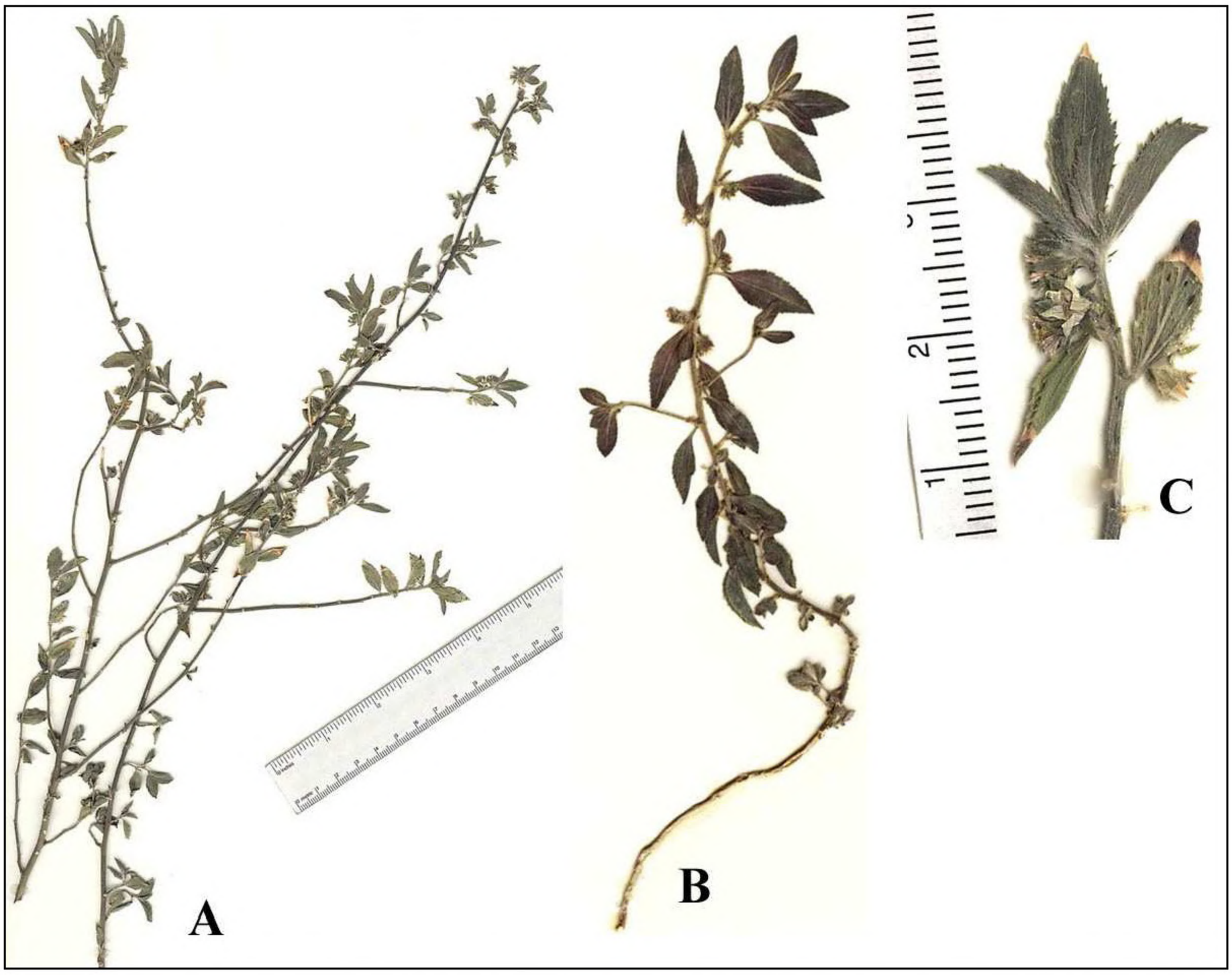

Figure 3. *Argythamnia adenophora.* (A & C) Base of Sierra Estrella, 6 mi NNE of Mobile, Maricopa Co., 29 Mar 2000, *Landrum 9687* (ASU). (B) N of Parker, Holiday Harbor near Castle Rock, Yuma Co., 9 Mar 1974, *Russell 74-14-HHS* (ASU).

Known from two records in central part of Organ Pipe.

Southwestern Arizona and western Sonora. *Argythamnia adenophora* is replaced by *A. claryana* Jepson in southeastern California and in western Arizona northward from the range of *A. adenophora*. *Argythamnia claryana* differs most notably in having herbage with numerous 2-armed hairs and generally more slender glands (Ramírez-Amezcua & Steinmann 2013; Steinmann & Felger 1997). *Argythamnia claryana* is sometimes treated as a synonym of *A. adenophora.*

OP: Twin Peaks, near Visitor Center, 1800–1900 ft, S-facing volcanic slope, *Van Devender 19 Feb 1984*. Puerto Blanco Mts, 2 mi E of Visitor Center on Ajo Loop Road, SW-facing rhyolitic rock shelter, 1800 ft, 15 Apr 1985, *Van Devender 85-107.*

Argythamnia brandegeei Millspaugh var. **intonsa** (I.M. Johnston) J.W. Ingram
[*Ditaxis brandegeei* (Millspaugh) Rose & Standley var. *intonsa* I.M. Johnston]
Sonoran silverbush. Figure 4.

Slender, and usually sparsely-branched perennials often 1–2.5 m tall, sometimes with a woody trunk to 3 cm in diameter. Stems 4–8 mm diameter in the first season, herbaceous and pithy, brittle, semi-succulent, with long internodes. Young stems glabrate or sparsely pubescent, the leaves mostly sparsely pubescent and becoming glabrate with age; capsules sparsely to densely covered with

coarse, 2-armed hairs; herbage often of an unusual blue-green color usually accentuated when dry, or sometimes reddish. Foliage sparse; leaves (3) 5–9.5 × (0.7) 1–2.8 cm, quickly drought-deciduous, usually present only on upper nodes, petioled, the blades lanceolate to sometimes elliptic, the margins with small gland-tipped teeth. Stipules glandular, horn-like, 0.4–0.5 mm long, quickly deciduous or perhaps sometimes absent. Male and female flowers occur on the same plant. Flowers yellow-green, the male flowers with laciniate-fringed petals. Seeds 3.5–4 mm long, ovoid, and brown. Flowering at various seasons.

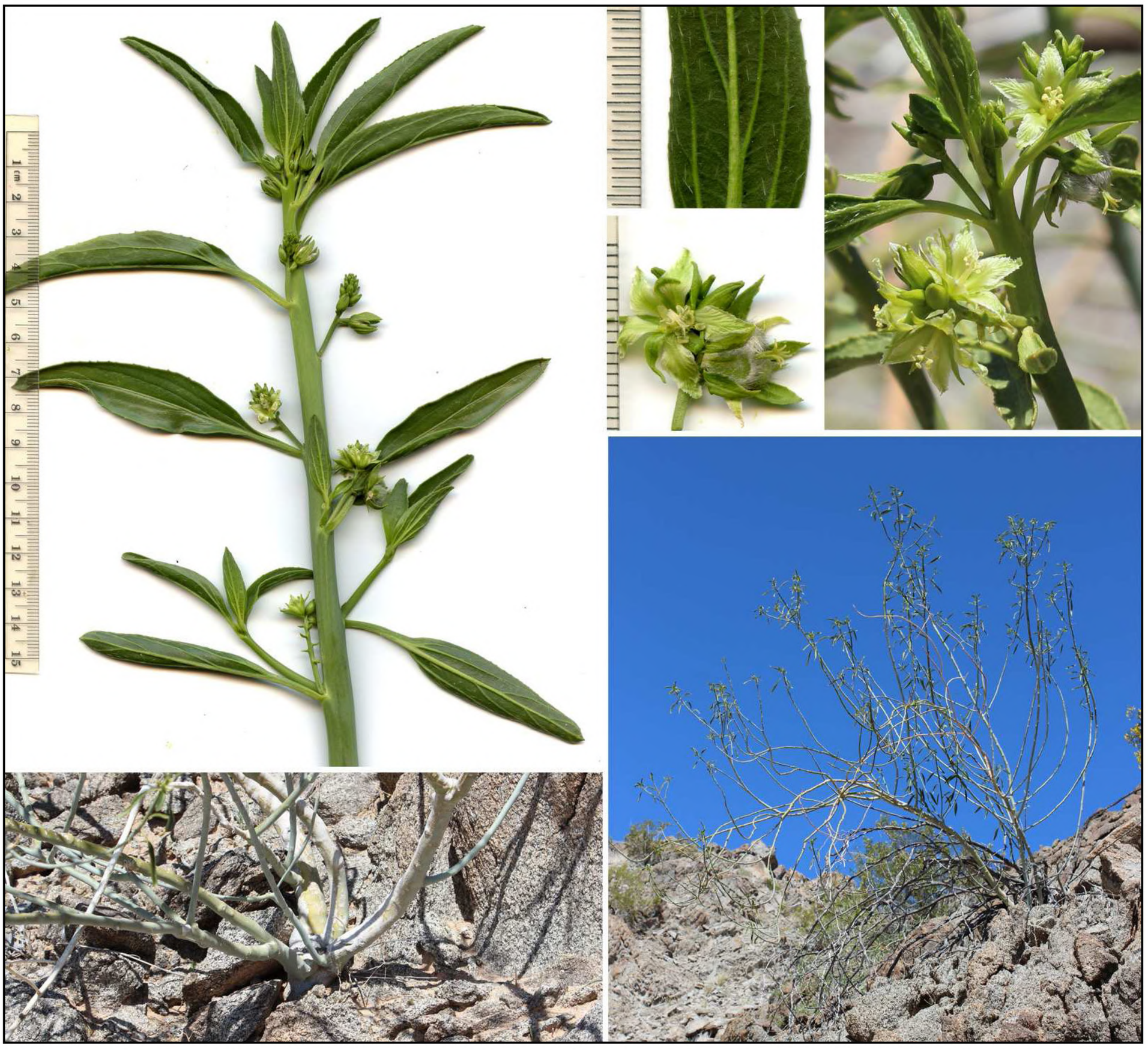

Figure 4. *Argythamnia brandegeei* var. *intonsa*. Granite hill about 0.1 mile S of Mex Hwy 2, 123 km W of Sonoyta, E side of Sierra Nina (= Sierra del Águila), Sonora, 7 Mar 2015.

Thinly distributed in the Tule and Cabeza Prieta mountains and common in the Gila Mountains north of the Tinajas Altas Region, where it approaches the Tinajas Altas Region at the Fortuna Mine site. This unique and rather strange plant generally grows from crevices of canyon walls and rock faces in hot, arid habitats. Often heavily browsed by bighorn sheep (Simmons 1966) and sometimes damaged by freezing weather (e.g., *Rutman 17 Feb 2002*, below).

Two varieties are recognized (Ramírez-Amezcua & Steinmann 2013), but the differences seem rather insignificant. Variety *intonsa* occurs in southwestern Arizona, northwestern Sonora, and both Baja California states. Variety *brandegeei* also occurs in both Baja California states and is characterized as being glabrous. The Arizona and Sonora plants match var. *intonsa*, distinguished from var. *brandegeei* "only in possessing a few scattered, very coarse, appressed, malpighian hairs on the leaves and young stems, and in the densely setose-hispid capsules" (Wiggins 1964: 786). The term *intonsa*, "unshaven," refers to the hairy ovaries and capsules. However, an occasional specimen from Sonora (e.g., *Turner 59-308*) is sparsely hairy or the ovaries glabrous or glabrate.

CP: Tule Tanks, 4 Dec 1935, *Goodding 4358*. Cabeza Prieta Tanks, 19 Mar 1960, *Monson 2*. Tule Mts, 1200 ft, about 2 dozen browsed plants with new leaves and branches, 10 Apr 1994, *Harlan 440*. Tule Mts, UTM 12 244001, 3552930, 1600 ft, steep granite boulder & bedrock S-facing slope, fewer than ten plants seen, some damaged by recent [freezing] temperatures, *Rutman 17 Feb 2002*.

Yuma Co.: The specimen label: "Stony wash in the desert western foot of Fortuna Mtns., snaky shrub 2–3 m. high, March 27, 1935, *Aven Nelson, Ruth A. Nelson No. 1303*" (RM).

†**Argythamnia lanceolata** (Bentham) Müller Argoviensis
[*Ditaxis lanceolata* (Bentham) Pax & K. Hoffmann]
Narrow-leaf silverbush. Figure 5.

Sparsely to densely branched and silvery-pubescent perennial herbs to subshrubs, and also flowering in the first season; often forming clumps 30–70 cm tall. Stems slender and brittle, the herbage silvery hairy during dry seasons, the new growth greener, more sparsely pubescent, and the leaves larger and thinner following hot, wet weather. Leaves 5–42 × 2–9 mm, linear lanceolate to broadly lanceolate; stipules bristle-like, ± 1 mm long. Male and female flowers occur on the same plant or perhaps on different plants. Flowers green and white, inconspicuous; warmer months. Seeds 2.3–2.5 mm long, reticulate with shallow craters having radiating lines, the seed base flat (the seed will sit on end, being "chunkier" than those of *D. serrata*).

Common and widespread across the flora area; washes, canyons, bajadas, and rocky slopes to summit elevations. Often heavily browsed, including by bighorn sheep (Simmons 1966), chuckwallas, and rabbits; these browsed plants sometimes reduced to clusters of stem stubs. Monson (1955: 3) reported that "bighorn sheep go to extreme lengths to gather the scattered sprouts and sparse leaves." The new growth is sometimes freeze-damaged. It has grown in the flora area for more than eight millennia.

Nearly throughout the Sonoran Desert in Arizona, California, both Baja California states, and Sonora.

OP: Tres Alamos Canyon, *Nichol 24 Feb 1939*. Above Dripping Springs, Puerto Blanco Mts, monoecious but mostly staminate, 16 Apr 1952, *Parker 7946*. Quitobaquito, 14 Sep 1988, *Felger 88-458*. 0.5 mi S of mouth of Alamo Canyon, *Warren 18 Apr 1975*. Alamo Canyon, *Rutman 5 Sep 1999* (ORPI). 2.3 mi N of junction Puerto Blanco Drive & Pozo Nuevo Rd, *Rutman 30 Aug 2001* (ORPI). †Puerto Blanco Mts, on ridge, leaves, capsules, seeds, 980 to 3440 ybp (8 samples).

CP: Tule Tank, 15 Apr 1941, *Benson 10801*. Near Cabeza Prieta Tanks, *Simmons 25 Oct 1962* (CAB). Charlie Bell Pass, 3 Apr 1992, *Whipple 3935*. Base of Scarface Mtn, 1650 ft, *Autenreith 20 March 1992* (DES). Observations: 0.5 mi S of Sunday Pass, 2600–2700 ft, 15 Nov 2003, *James W. Cain III;* Agua Dulce Pass, Buck Mt Tank, North Pinta Tank, 13 & 14 Jun 1992, *Felger*.

TA: Tinajas Altas Mts: 5 Mar 1927, *Harrison 3611*; 1530 ft, 26 Oct 2004, *Felger 04-80* (ARIZ, ASU, CAS, TEX). Borrego Canyon, 16 Jun 1992, *Felger* (observation). 1 mi N of Tinajas Altas Pass road, 1250 ft,. 19 Mar 1983, dioecious, *Yeatts 433* (DBG: KHD). Tinajas Altas Mts, †Butler Mts, leaves, fruits, 8160 ybp.

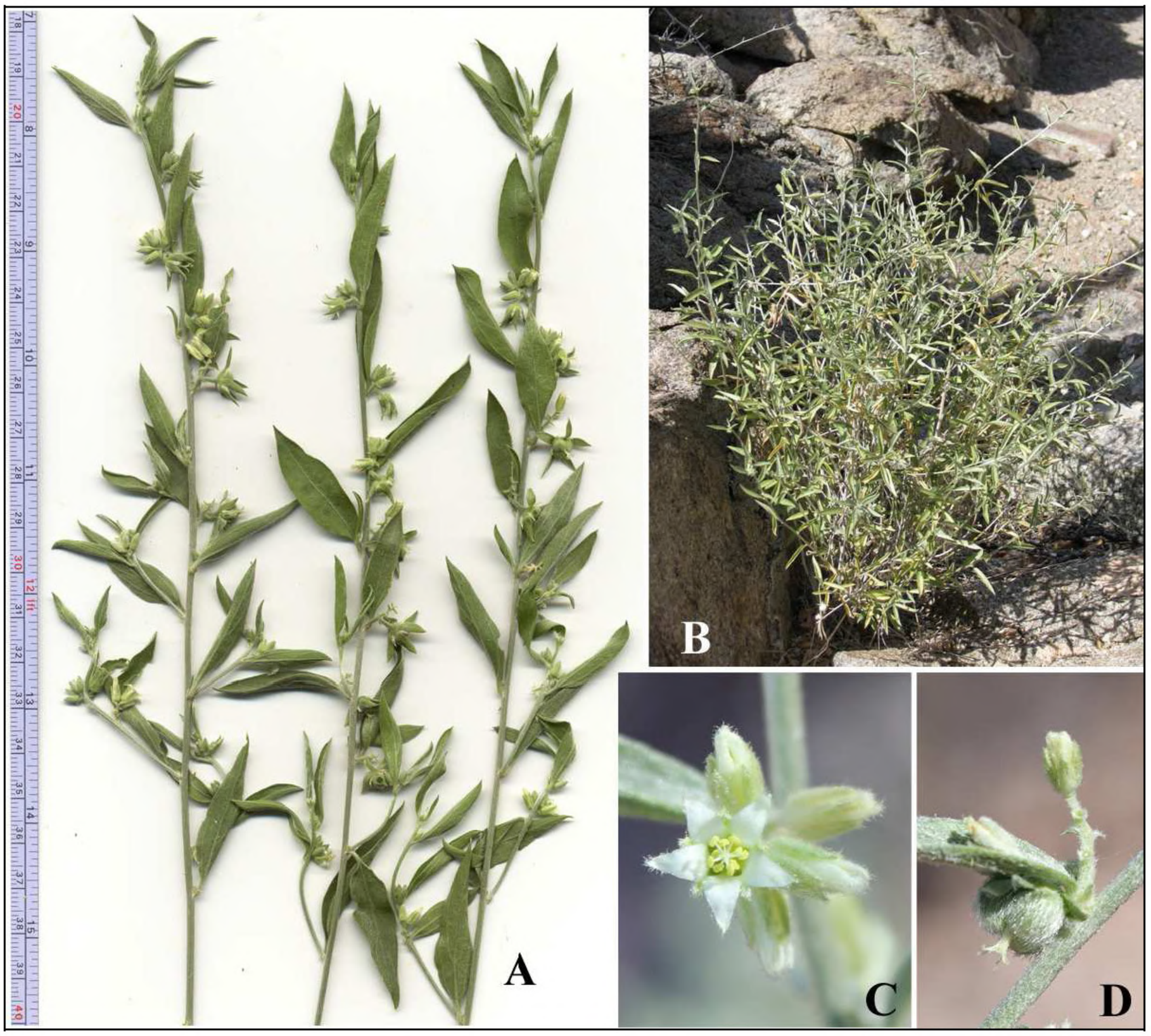

Figure 5. *Argythamnia lanceolata*. (A) Alamo Canyon, 15 Sep 2013. (B) Canyon, N side of Little Ajo Mts, 20 Oct 2008. Estes Canyon, 27 Feb 2014: (C) male flower, (D) female flower and male flower bud.

†Argythamnia serrata (Torrey) Müller Argoviensis
[*Aphora serrata* Torrey. *Ditaxis serrata* (Torrey) A. Heller. *Argythamnia neomexicana* Müller Argoviensis. *Ditaxis neomexicana* (Müller Argoviensis) A. Heller]
New Mexico silverbush; *cualilla*. Figure 6.

Non-seasonal ephemerals or small, short-lived herbaceous perennials; often much branched, and with 2-armed hairs. Leaves mostly 1.2–3.5 cm long, elliptic or oblanceolate, the tip acute to obtuse, or truncate, the margins entire or with a few small teeth; leaves longer (to 5 cm), broader, greener, not as thick, and less hairy when produced during warm, wet conditions than in drier or drought conditions; stipules minute, soon deciduous. Flowers green and white, small and inconspicuous. Male and female flowers occur on the same plant. Male flowers: sepals green, the petals longer than the sepals, obovate, white with red-purple veins, the glands 0.5 mm wide, transparent-membranous, with age becoming yellow-brown and thickened, the staminal column 1.5 mm long, the stamens in 2 whorls near the column apex. Female flowers: sepals 3.2–4 mm long, the petals 1.5–3 mm long. Seeds 2 × 1.5–1.6 mm, ovoid with a pointed tip, brown with low hairs forming fine radiating lines from minute crater-like pits or a reticulate pattern (the radiating lines often not formed on immature seeds).

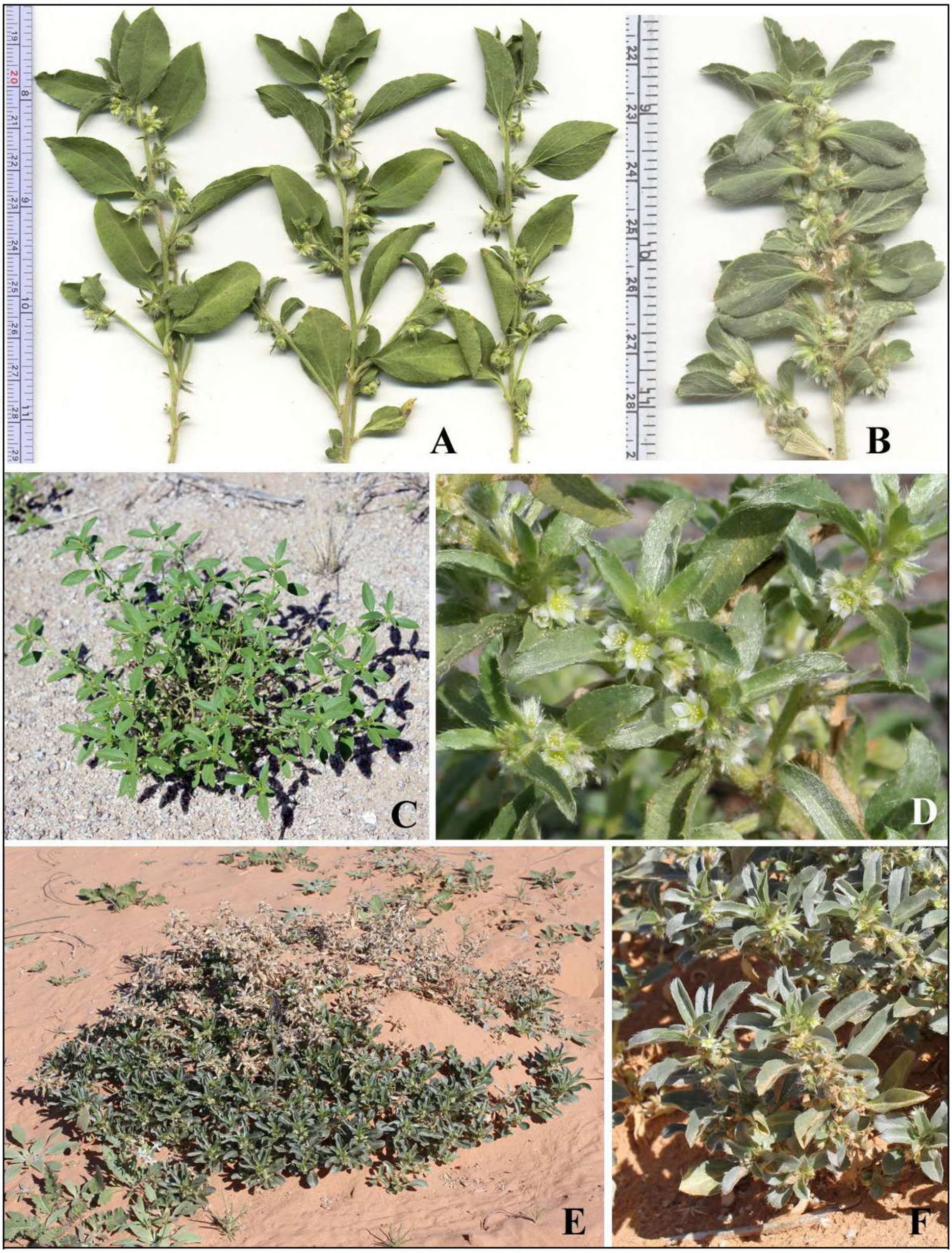

Figure 6. *Argythamnia serrata*. (A) Why, 15 Sep 2013. (B) Gran Desierto, Sonora, 5 Mar 2014. (C) International boundary W of Quitobaquito, 5 Sep 2013. (D) Dos Lomitas, 22 Feb 2005. (E) Pinta Sands, 11 Feb 2013. (F) Gran Desierto near Mex Hwy 2, 5 Mar 2014.

Common and widespread throughout most of the flora area in many habitats, including washes, plains, bajadas, and rocky slopes, and especially on loamy flats. As with *A. lanceolata*, *A. serrata* has grown in the flora area for at least eight millennia.

Southwestern United States and Mexico to Guatemala.

Ramírez-Amezcua and Steinmann (2013) treated *A. neomexicana* as a synonym of *A. serrata*, which has priority as the basionym *Aphora serrata*. *Argythamnia serrata* sensu stricto is a sand-adapted plant found on dunes and sand flats in the southern part of Cabeza Prieta, and distinguished from *A. neomexicana* sensu stricto by its robust habit of growth, stouter and deeper taproot, generally larger hairs, lighter-colored foliage, and usually broader and blunter (commonly truncate) leaves. Their local distributions are narrowly separated by differences in habitat.

OP: Dripping Springs, Puerto Blanco Mts, 15 Apr 1952, *Parker 7915*. Quitobaquito, 13 Sep 1986, *Felger 86-291*. 2.3 mi N of junction Puerto Blanco Drive & Pozo Nuevo Rd, *Rutman 30 Aug 2001* (ORPI).
CP: Pinacate Plateau, *Goodding 29 Nov 1938*. N side of Tule Mts, 2 Feb 1992, *Felger 92-61*. Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-661*. Pinta Sands, 15 Sep 1992, *Felger 92-783*.
TA: Camino del Diablo, E of Raven Butte, 29 Oct 2001, *Felger 01-589*. Mexico border at mouth of Frontera Canyon, 18 Mar 1998, *Felger,* observation. †Butler Mts, leaves, fruits, seeds, 3820 & 8570 ybp.

†Argythamnia sp.
TA: †Tinajas Altas, seeds, 5860 to 8255 ybp (3 samples).

Croton

The two species in the flora area are perennials (the genus elsewhere includes annuals to perennials, shrubs, and trees) with stellate hairs or stellate-lepidote scales. Sap clear (those in the flora area). Leaves alternate, margins entire (those in the flora area), becoming orange as they age and fall. Fruit a 3-seeded capsule. Seeds with a caruncle.

Warm regions, especially in the tropics, with centers of diversity in Mexico and Brazil; more than 1200 species worldwide, including over 700 in the New World, making it one of the "giant genera" of angiosperms (Frodin 2004; Govaerts et al. 2000; van Ee et al. 2011).

1. Branches firm and woody; herbage with stellate pubescence; male and female flowers on the same plant; mostly in rocky soils or gravelly washes..... **Croton sonorae**
1. Branches mostly herbaceous and flexible; herbage with stellate-lepidote scales; male and female flowers on separate plants; dunes and sand flats..... **Croton wigginsii**

†Croton sonorae Torrey
Sonoran croton; *rama blanca*. Figure 7.

Shrubs mostly 0.4–1.5 m tall, the wood hard and the bark dark-gray to blackish. Leaves 2.5–4 cm long, drought-deciduous, variable in size depending on soil moisture, petioled; leaf blades lanceolate to ovate, densely stellate-pubescent when young, becoming sparsely haired or glabrate with age, especially the upper surfaces, and often orange or tinged with orange; margins entire or slightly and irregularly sinuate; stipules not evident (those in the flora area). Male and female flowers on the same plant, both with petals; female flowers green and inconspicuous, the male flowers white; flowering at various seasons, especially during the summer rainy season. Seeds 4.7–5.5 mm long, broadly ovoid, shiny, and mottled.

Mostly in canyons and rocky slopes, especially west and south-facing exposures. Widely scattered in Organ Pipe, at least in the Ajo, Puerto Blanco, and Santa Rosa mountains, and granitic mountains on the east side of Cabeza Prieta. Many *C. sonorae* plants in the flora area are relatively

small and stunted, probably as a result of the arid conditions and repeated freeze damage. It has an 8600-year history in Puerto Blanco and Ajo mountains.

Southern Arizona to Sinaloa and Baja California Sur; and disjunct in Guerrero, Puebla, and Oaxaca.

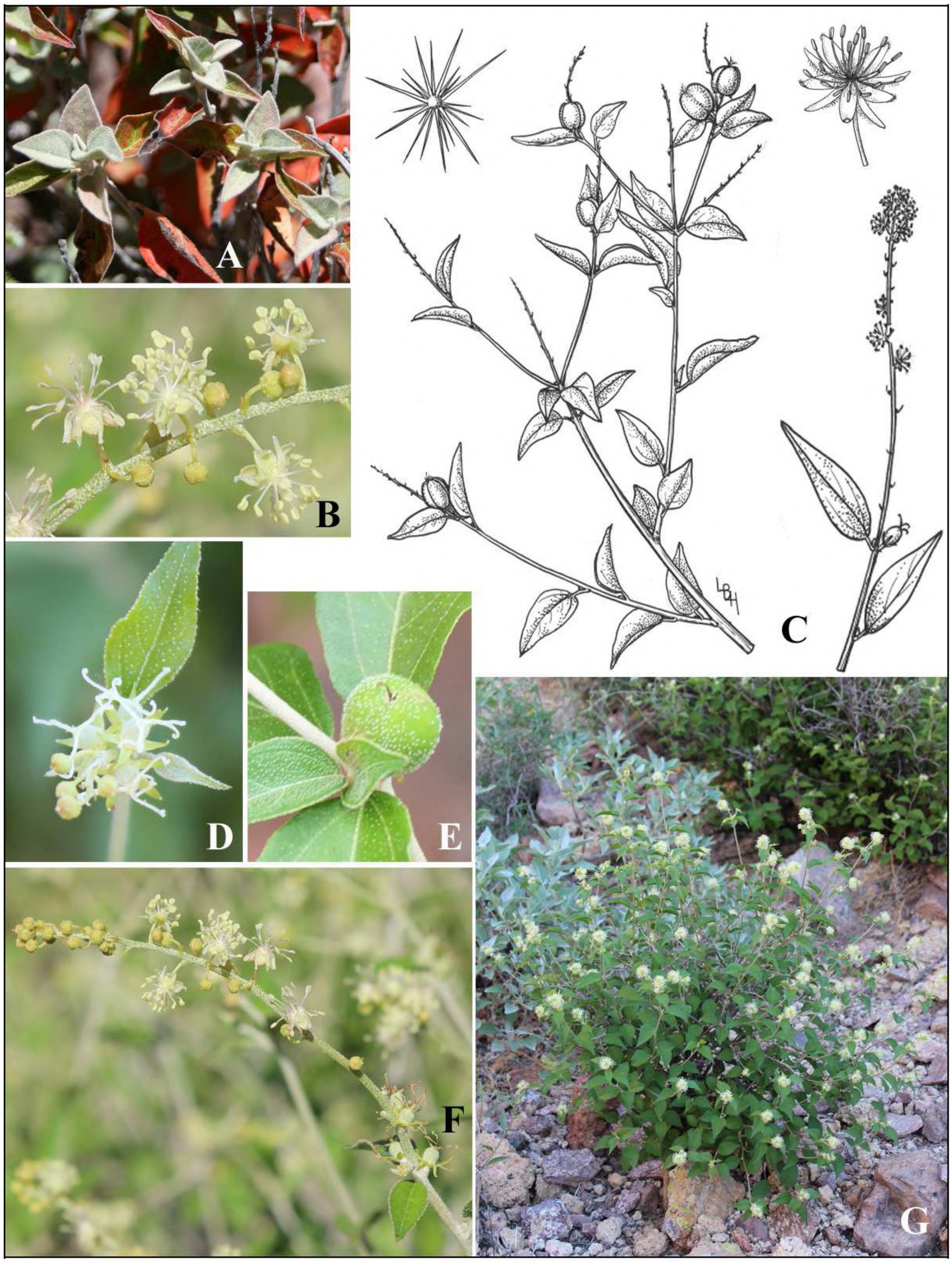

Figure 7. *Croton sonorae*. (A) S-facing slope, Bull Pasture Trail, 6 Mar 2005. (B, D–G) Foothills of Pinkley Peak, 8 Aug 2013. (C) By Lucretia Breazeale Hamilton.

Croton sonorae is a member of section *Adenophylli*, the largest of the New World sections of *Croton* with approximately 223 species (Van Ee et al. 2011). Van Ee and Berry (in press) report "stipules subulate, to 1 mm." However, Felger looked at specimens at ARIZ and Walter Fertig looked at specimens at ASU and no stipules were detected, and Wiggins (1964: 78) says "stipules obsolete."

OP: Bull Pasture Trail, 11 May 1978, *Bowers 944*. Walls Well Rd, *Van Devender 30 Aug 1978*. Growler Mts, W of Growler Pass, 7 Mar 2003, *Rutman 2003-249* (ORPI). Foothills of the Puerto Blanco Mts, N of Pinkley Peak, 2020 ft, shrub 1–1.5 m tall, *Rutman 8 Aug 2013*. †Alamo Canyon, fruits, seeds, 1150 to 8590 ybp (3 samples). †Puerto Blanco Mts, on ridge, leaves, seeds, 980 to 3400 ybp (4 samples).

CP: Vicinity of Agua Dulce Spring, Agua Dulce Mts, 2080 ft, dwarfed shrub, ca. 40 cm tall, not common, 13 Jun 1992, *Felger 92-574*.

Croton wigginsii L.C. Wheeler
[*Croton arenicola* Rose & Standley, 1912. Not *Croton arenicola* Small, 1905]
Gran Desierto dune croton. Figure 8.

Herbaceous perennials to subshrubs to at least 1 m tall and scarcely woody at base; densely pubescent with silvery stellate-lepidote scales. Stems mostly erect, the branching pattern strict, the plants taller than wide. Leaves drought-deciduous, highly variable in size depending on soil moisture, often 1.5–6 cm long, petioled; the blades linear to narrowly lanceolate, the midrib prominent; minute, deciduous, cylindrical glands in the position of stipules. Male and female flowers on separate plants, the male flowers yellow, the female flowers green; both lacking petals. Seeds 4.4–7.8 mm long (based on specimens in adjacent Sonora). Flowering non-seasonally.

Cabeza Prieta on dunes and windblown sands in the vicinity of the Pinta Sands and Pinacate Lava Flow and westward in Yuma County near the international border, but not at Yuma (where one finds *C. californicus*). Also northwestern Sonora including the Gran Desierto (the type locality), desert areas in southeastern California including the Algodones Dunes, and northeastern Baja California. *Croton wigginsii* reaches 2.5 m tall in the dunes of the Gran Desierto in northwestern Sonora near the flora area (Felger 2000).

Croton wigginsii is a member of section *Drepadenium* with six species in North America and northern South America (Van Ee et al. 2011). It is an easily recognized allopatric member of the *C. californicus* complex, although the relationships, including geographic boundaries and interfaces of *C. californicus* and *C. wigginsii*, seem to be poorly resolved. Leaf size and shape and seed size are the most obvious distinctions, but leaf shape is highly variable and seeds are often not available. They usually can be distinguished as follows:

1. Stems divergent, the branches spreading, the plants often as wide as or wider than tall; leaf blades elliptic to narrowly oblong; seeds 4.0–4.5 mm long (populations in Arizona and Sonora) ..... **C. californicus**
1. Stems mostly erect, the plants generally taller than wide; leaf blades linear to linear-lanceolate or narrowly lanceolate; seeds 4.4–7.8 mm long..... **C. wigginsii**

The Cahuillas used *C. californicus* to treat earache and to relieve congestion from colds, but the plant is toxic and was used in small doses (Bean & Saubel 1972). However, the Cahuillas probably used *C. wigginsii* as well *C. californicus*.

CP: Pinta Sands: *Simmons 24 Nov 1962* (CAB); [Pinta Sands] 32°05′35″N 113°26′47″W, common on dunes with *Hilaria rigida, Stillingia* sp., *Aristida* sp., 9 Mar 1980, *Reichenbacher 446*. East Pinta Sands, 16 Jun 1992, *Felger 92-630A* (staminate), *Felger 92-630B* (pistillate). West Pinta Sands, only seen on moving dunes, bushy perennial ca. 60 cm tall, 11 Jan 2002, *Felger 02-19* (pistillate), *Felger 02-20* (staminate).

Figure 8. *Croton wigginsii*. Dunes 25 miles SW of Sonoyta on Mex Hwy 8: (A) 7 Sep 2014; (B) 27 Mar 2010; (C–E) 6 Feb 2014. (F) Pinta Sands, W of lava flow, 21 Jan 2015.

Euphorbia – Spurge

This is the largest genus in the flora area, with 18 species. Annuals or perennial herbs (those in the flora area) with latex (milky sap). Leaves alternate, opposite, or whorled, the blades symmetrical or not. Individual flowers borne in a cup-like structure, the cyathium, "present in every species of the genus but nowhere else in the plant kingdom" (euphorbiaceae.org), the whole structure superficially resembling a single "normal" flower (Figure 9). Each cyathium with fused bracts forming an involucre surrounding the flowers and bearing at its top 1–5 glands (those in the flora area); these glands with or without a petaloid (petal-like) appendage on the outside margin (width of

petaloid appendages measured perpendicular to the gland). Each cyathium with few to many minute male flowers and a single, much larger female flower (those in the flora area; elsewhere male and female flowers are sometimes on separate plants). Each male flower reduced to a single stamen fused to a short pedicel (stalk). The female flower reduced to a single pistil (ovary, styles, and stigmas) borne on a pedicel, extending beyond the edge of the cyathium and turning down and away from the male flowers (stamens). Styles 3, usually bifid (the 3 divided into 6 branches). Fruit a 3-seeded capsule. Seeds with or without a caruncle, and with or without mucilage when wet.

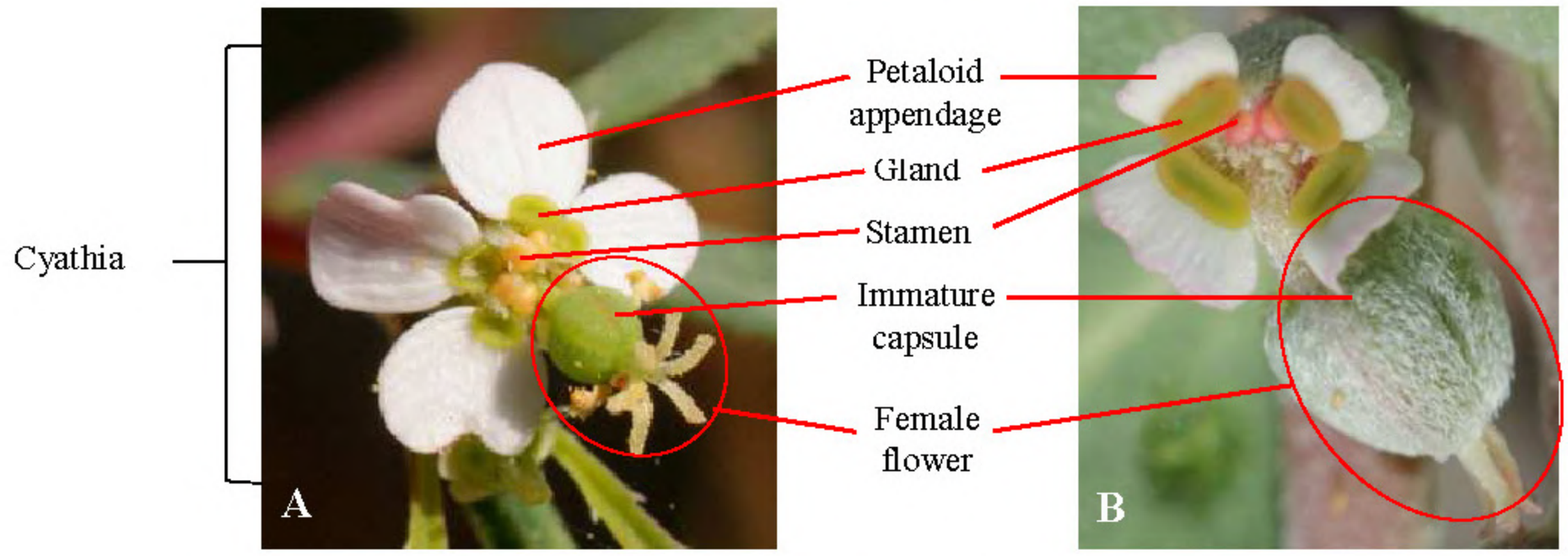

Figure 9. Cyathia of *Euphorbia*. (A) *E. florida*, each stamen is a male flower (from photo by Patrick Alexander; Centro Ecológico de Sonora, Hermosillo, 28 Oct 2006). (B) *E. pediculifera*, I-10 frontage road in Pima County 5–6 mi W of Cochise Co. line, 10 Aug 2014 (photo by Nathan Taylor).

Euphorbia is distributed worldwide with at least 2000 species and amazingly diverse growth forms, including the varied succulents of southern Africa; it is one of the world's largest genera along with *Astragalus* and *Carex* (Frodin 2004). The genus has traditionally been classified into five fairly well-marked major taxa, variously treated as subgenera or separate genera, four of them in the flora area: *Agaloma, Chamaesyce, Esula*, and *Poinsettia*. Current consensus recognizes a single, giant but monophyletic genus (e.g., Horn et al. 2012; Yang & Berry 2011). Although controversy for lumping or splitting of *Chamaesyce* and *Euphorbia* spanned more than a century, molecular phylogenetic studies place *Chamaesyce* well nested in *Euphorbia* (e.g., Steinmann & Porter 2002; Yang et al. 2012). Extensive phylogenetic studies of *Euphorbia* taxa worldwide resulted in defining four major clades or subgenera, but with alignments quite different from the traditional five subgenera (e.g., Horn et al. 2012, Yang & Berry 2011, and Yang et al. 2012). *Euphorbia* species in southwestern Arizona are in two subgenera: *Esula*, with a single species in the flora area, and *Chamaesyce*, a greatly expanded but monophyletic subgenus that includes the traditional *Chamaesyce* as well as *Agaloma* and *Poinsettia*. Spurges in southwestern Arizona are distributed among the following monophyletic taxa:

Subgenus **Chamaesyce**
  Section **Anisophyllum**
    Subsection **Hypericifoliae** (14 species)
  Section **Poinsettia**
    Subsection **Erianthae**: *E. eriantha*
    Subsection **Exstipulatae**: *E. exstipulata*
    Subsection **Stormieae**: *E. heterophylla*
  Subgenus **Esula**, section **Helioscopia**: *E. spathulata*

1. Plants glabrous or pubescent; leaves variable, mostly petioled; cyathia variously colored, solitary or clustered; petaloid appendages present or absent; ovaries and capsules not warty; seeds 0.7–4 mm long, with or without a caruncle; widespread. ..... **Euphorbia** subgenus **Chamaesyce**
1. Plants glabrous; leaves sessile, obovate to broadly oblong, rounded or blunt at the tip; cyathia green to yellow-green, solitary in the axils of a pair of opposite leaves; petaloid appendages absent; ovaries and capsules conspicuously warty; seeds 1.5–2 mm long, with a minute white caruncle; in the flora area known only from Las Playas in Cabeza Prieta..... **Euphorbia** subgenus **Esula**

Euphorbia subgenus **Chamaesyce**

Subgenus "*Chamaesyce* contains around 600 species and includes the largest New World radiation within the Old World-centered genus *Euphorbia*. It is one of the few plant lineages to include members with C_3, C_4, and CAM photosynthesis, showing multiple adaptations to warm and dry habitats. This subgenus includes North American-centered groups that were previously treated at various taxonomic ranks under the names of '*Agaloma*', '*Poinsettia*', and '*Chamaesyce*'" (Yang et al. 2012: 764). Two of the 15 sections of subgenus *Chamaesyce* occur in southwestern Arizona.

1. Plants with sympodial growth; stems having obvious upper (dorsal) and lower (ventral) sides; leaves opposite, the blades asymmetric basally; stipules present (minute in *E. arizonica* and *E. setiloba*); seeds 0.7–2.6 mm long, lacking a caruncle.
..... **Euphorbia** section **Anisophyllum**
1. Plant growth not sympodial; stems not having obvious upper (dorsal) and lower (ventral) sides; at least some leaves alternate (or opposite in *E. exstipulata*), the blades symmetrical; stipules absent or glandular; seeds 3–4 mm long (2–3 mm in *E. exstipulata*), with or without a caruncle.
..... **Euphorbia** section **Poinsettia**

Euphorbia section **Anisophyllum** subsection **Hypericifoliae**

Annual or perennial herbs (those in the flora area) and rarely shrubs. Two subsections of *Anisophyllum* are recognized and all but 3 species (not in the flora area) are in subsection *Hypericifoliae*.

These plants have sympodial growth, a specialized growth form with early abortion of the main shoot: the apical meristem of the main stem of the seedling aborts above the cotyledon node and the plant develops from lateral branches, and these lateral shoots branch dichotomously (e.g., Hayden 1988; Koutnik 1987; Yang et al. 2012). This growth form is a synapomorphy for section *Anisophyllum*, in which essentially the entire plant body resembles a synflorescence (Yang et al. 2012: 775). No other group in the Euphorbia family has this growth form. This branching pattern contributes to the prostrate or flat, spreading habit of growth seen in some of the species. Characteristics of *Anisophyllum* include C_4 photosynthesis, stems having obvious upper (dorsal) and lower (ventral) sides, opposite leaves and leaf blades with asymmetric bases, and presence of stipules (minute in *E. arizonica* and *E. setiloba*), seeds without a caruncle. Other features include leaves petioled although the petioles are sometimes very short, stipules on the ventral side of the stem often different from ones on the dorsal side, and cyathia with 4 glands (those in the flora area; sometimes 5–7 elsewhere).

Hypericifoliae is worldwide with about 360 species, and constitutes the largest lineage of C_4 plants among the eudicots (Yang & Berry 2011). Dark green veins that are associated with Kranz anatomy and often visible on C_4 leaves are prominent in many of the local species (Figure 10). These Kranz lines appear as dark veins alternating with light-colored stripes angling from the midvein toward the leaf margins and apex. Yang et al. (2012: 774) point out, "Together with juvenile flowering, copious seed production, and C_4 photosynthesis, sect. *Anisophyllum* has been very

successful in colonizing warm and semi-desert areas and disturbed habitats worldwide." And we add that it has also been successful in desert habitats.

Figure 10. *Euphorbia prostrata* leaf displaying Kranz anatomy; Lamesa, Dawson Co., TX, 11 Oct 2011, photo by Nathan Taylor).

Hypericifoliae species are common across the Sonoran and Chihuahuan deserts, with 33 species in the Sonoran Desert (Wheeler 1936, 1941; Wiggins 1964) and 13 species in the flora area. Most of the Sonoran Desert species can be readily identified by their distinctive seeds (Figure 11). Seeds of *E. micromera* and *E. polycarpa*, however, appear indistinguishable from each other. As in the case of *Cryptantha* sensu lato (Boraginaceae; e.g., Felger et al. 2015), rather technical and microscopic features are used in the keys, but with a little practice one can distinguish the species by the gross appearance of the plants. Those in the flora area are distinct from one another, with no indication of intermediates or hybrids, although several species often occur together. In Mexico these plants are generally known as *golondrina* (Spanish for "swallow," but the association with this bird is not known) and the general Hia-Ced O'odham name is vi'ibam (see *E. polycarpa*).

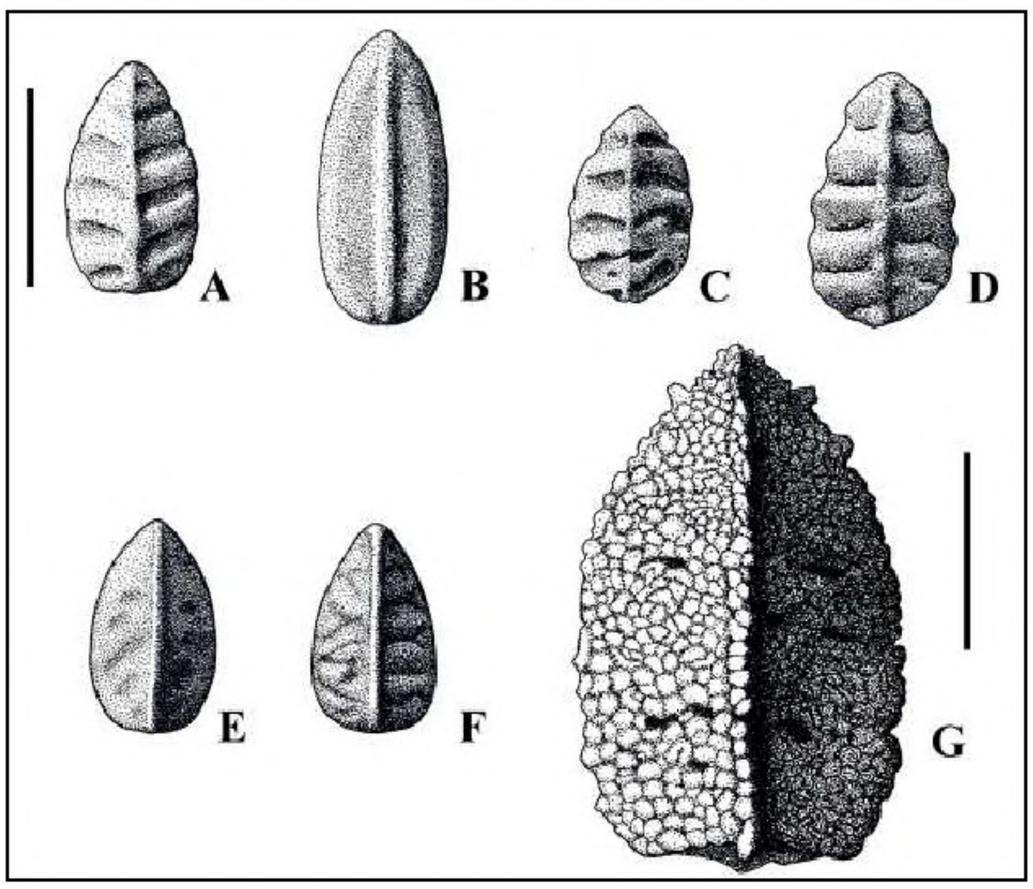

Figure 11. *Euphorbia* (Hypericifoliae) seeds. (A) *E. abramsiana*; (B) *E. albomarginata*; (C) *E. arizonica*; (D) *E. pediculifera*; (E) *E. polycarpa*; (F) *E. setiloba*; (G) *E. trachysperma*. By Matthew B. Johnson. Bar = 1 mm.

Pubescence, growth form, and color can be highly variable and all of the perennial species can flower in their first season. For example, *E. micromera* and *E. polycarpa* plants may be green or reddish, ephemeral to perennial, and glabrous or variously pubescent. *Euphorbia micromera* has cyathia without petaloid appendages, and appendages are lacking or reduced on *E. abramsiana, E. hyssopifolia, E. prostrata,* and *E. trachysperma*. Others, such as *E. melanadenia* and *E. polycarpa*, generally have conspicuous petaloid appendages, although young, developing cyathia and drought-stressed plants may have greatly reduced or no appendages. Color or color patterns often can be helpful for identification, but may also be variable with season, and even between individual plants at the same place and time. *Euphorbia abramsiana* and *E. micromera* usually have ovaries and capsules with well-defined red stripes or lines along the angles (keels) and furrows (the crease where the capsule splits, the carpel margins) and similar coloration is often seen on *E. albomarginata, E. pediculifera, E. polycarpa*, and some others. This red color is not seen on *E. hyssopifolia* and *E. trachysperma*, the two species with robust ascending growth.

The Hypericifolia tend to be pollination generalists; the major pollinators are probably small bees, wasps, and flies, but ants and butterflies also do their share (e.g., Krombein 1961; Webster 1994). Rutman found flowering *E. albomarginata* to have a fairly strong fragrance and on the same day (7 Mar 2015) observed flowering *E. polycarpa* swarming with small flying insects as well as ants. However, at least some hypericifolia are self-pollinating, especially the weedy ones, and presumably the majority of the species are self-compatible (e.g., Ehrenfeld 1976, 1979). It is an attractive hypothesis that there is a trend for species with reduced appendages to be selfing and those with larger appendages to be outcrossing and fragrant.

Most of the species in the Hypericifolia clade possess a seed coat that becomes mucilaginous and sticky when wet (e.g., Jordan & Hayden 1992; Pammel 1891), and this type of seed coat is otherwise rare in the *Euphorbia* genus (Yang and Berry 2012). Mucilaginous seed coats occur in many other angiosperm families (e.g., Polemoniaceae, Lindley 1828) and have been shown to facilitate seed hydration and germination as well as seed dispersal, including possible long-distance dispersal (e.g., Ebrahimzadeh et al. 2000; Gutterman & Shem-Tov 1997; Penfield et al. 2001).

Seeds of all Hypericifolia species in the flora region produce varying amounts of mucilage when wet, with the notable exception of *E. platysperma* (see species accounts). Upon drying this mucilage makes the seed adhere tenaciously to the substrate. Put a drop of water on one of these seeds and usually within 10 seconds a "slime jacket" forms and hair-like mucilaginous strands spring out, looking like fungal hyphae (use a dissecting or compound microscope, or even a hand lens). This "mucilaginous layer can reform repeatedly under alternating cycles of wet and dry conditions" (Jordan & Hayden 1992: 83). Even 1200-year-old seeds of *E. hyssopifolia* from a packrat midden became mucilaginous when wet (see species accounts).

These herbaceous euphorbias have an extensive history of medicinal use (e.g., Felger 2007; Felger & Moser 1985; Hrdlička 1908; Kearney & Peebles 1960; Moerman 1998). A few regional examples are given here. The Cahuillas made a decoction of the plant as a febrifuge and to treat chicken pox and smallpox, and an infusion was drunk to treat sores of the mouth (Bean & Saubel 1972). Use of these euphorbias to treat rattlesnake bite was widespread, and probably the source for the name rattlesnake weed for *E. albomarginata*. Among the Cahuillas a decoction was taken internally, or more commonly a poultice of the plant was applied to the snakebite (Bean & Saubel 1972). Describing the site of Fort Yuma in 1854, Lt. Nathaniel Michler (1987: 101) wrote that "euphorbia, a rank poison…[was] used by the Indians as an antidote against the bite of the rattlesnake." These spurges were also used to treat cuts, earaches, infections, sores, wounds, the bites of black widows and other spiders, and the stings of carpenter bees and honey bees (Bean & Saubel 1972; Cruz Matus, pers. comm. to Felger, unpublished notes of 1985 interview in Guaymas, Sonora;

Train et al. 1941; Zigmond 1981). Among the Gila River Pimas the plant was chewed as a laxative, but using too much would make one sick, and it was used in the same manner to eliminate intestinal worms (Rea 1997). The Seris mashed fresh herbage (mostly from *E. polycarpa*) with salt and oil and applied it as a poultice to swollen areas. They also used the plant to treat toothache or heart pain (Felger & Moser 1985). Cruz Matus (interview, 1985) in Guaymas, explained that the Yoemem (Yaquis) stored the dried plant for future use or chopped it up green if needed immediately. However, caution is advised since many members of the spurge family are known to be toxic.

1. Cyathia in dense, subcapitate and leafless (cymose) clusters..... **Euphorbia capitellata**
1. Cyathia mostly solitary, or sometimes few in the axils of leafy shoots.

2. Plants glabrous; stems orange, often with adhering sand; seeds 2.4 × 1.4 mm, grayish white, smooth on both sides, the inner face flat, smooth; restricted to windblown sands ..... **Euphorbia platysperma**
2. Plants glabrous or not; stems not orange and without adhering sand; seeds less than 2 mm long or if 2 mm or more then about as wide as long, whitish, brown, or black; not restricted to windblown sands.

3. Plants glabrous (or at least the capsules, or sometimes with a few stringy hairs at or near the nodes), often with one or a few erect or upright main axes; seeds 1.3–2.6 mm long, chunky, about as wide as long.

4. Leaves linear (conspicuously slender); petaloid appendages conspicuous; seeds 1.7–2 mm long, smooth between 2 or 3 low, transverse ridges..... **Euphorbia florida**
4. Leaves lanceolate to oblong; petaloid appendages mostly not conspicuous or absent; seeds 1.3–2.6 mm long, with few, shallow, transverse depressions or granulated.

5. Seeds 1.3–1.4 mm long, usually blackish at maturity, the faces with shallow transverse ridges (usually 3 or fewer)..... **Euphorbia hyssopifolia**
5. Seeds 2–2.6 mm long, usually gray to brown at maturity, the faces granulated and without transverse ridges..... **Euphorbia trachysperma**

3. Plants glabrous or pubescent, generally with several to many spreading to prostrate major stems; seeds 1.5 mm or less in length, longer than wide (except *E. hyssopifolia*).

6. Plants glabrous; stems often rooting at nodes; leaf blades all or mostly orbicular or nearly so; stipules conspicuous, usually white, and united into membranous scales. ..... **Euphorbia albomarginata**
6. Plants glabrous or pubescent; stems not rooting at nodes; leaf blades usually not orbicular, often ovate to obovate or oblong; stipules slender and inconspicuous or minute and not readily visible.

7. Petaloid appendages absent or sometimes minute; involucral glands about 0.1–0.6 mm wide.

8. Seed surfaces smooth or faintly wrinkled.

9. Involucral glands round, dot-like, 0.12–0.25 mm wide; stamens 2–5 per cyathium. ..... **Euphorbia micromera**
9. Involucral glands oval, 0.3–0.6 mm or more in width; stamens 15 or more per cyathium..... **Euphorbia polycarpa**

8. Seed surfaces with transverse ridges.

10. Leaves oval to oblong; capsules hairy (only or mostly hairy on ridges, especially toward base of capsule); seeds 0.7–0.8 mm long, the margins, crest, and ridges sharp-angled (ragged)..... **Euphorbia prostrata**
10. Leaves oblong; capsules glabrous (or essentially glabrous in *E. abramsiana*); seeds 1–1.4 mm long, the margins, crest, and ridges smooth (not ragged).

11. Plants mostly spreading to prostrate; largest leaves usually less than 13 mm long; leaf margins usually toothed near apex and along longest side; involucral glands 0.1–0.15 mm wide; seeds 1–1.2 mm long, grayish white to brownish at maturity, with 4–6 ridges..... **Euphorbia abramsiana**
11. Plants mostly erect to ascending; largest leaves usually over 13 mm long; leaf margins evenly serrated all around; involucral glands 0.2–0.4 mm wide; seeds 1.3–1.4 mm long, usually blackish at maturity, with usually 3 or fewer transverse ridges. ..... **Euphorbia hyssopifolia**

7. Petaloid appendages present (sometimes not developed in young cyathia or drought-stressed plants; these plants key out in both choices); involucral glands various.

12. Plants glandular-pubescent and sticky to the touch; cyathia narrowed or constricted at apex.

13. Annuals or perennials; glandular hairs slightly enlarged (club-shaped) at tip; petaloid appendages entire or moderately lobed (rounded at tip)..... **Euphorbia arizonica**
13. Annuals; glandular hairs not enlarged at tip; petaloid appendages with triangular, pointed segments, the cyathia thus appearing star-shaped..... **Euphorbia setiloba**

12. Plants glabrous or pubescent and sometimes glandular-pubescent but not sticky to the touch; cyathia not narrowed or constricted at apex.

14. Seed surfaces smooth or faintly wrinkled.

15. Herbage with evenly distributed appressed hairs, usually giving the plant a grayish appearance; ovaries and capsules densely hairy..... **Euphorbia melanadenia**
15. Herbage glabrous or with spreading hairs, not grayish in appearance; ovaries and capsules glabrous or sometimes sparsely pubescent..... **Euphorbia polycarpa**

14. Seed surfaces with conspicuous transverse ridges and grooves.

16. Herbage, cyathia and capsules hairy; cyathia 1.2–1.5 mm wide, the glands 0.6–0.9 mm wide, the petaloid appendages usually 0.5 mm or more in width (rarely absent or reduced on immature cyathia) ..... **Euphorbia pediculifera**
16. Plants glabrous, or hairy and capsules glabrous or glabrate; cyathia 0.4–0.9 mm wide, the glands 0.1–0.4 mm wide, the appendages to 0.4 mm wide (measured perpendicular to gland).

17. Plants mostly spreading to prostrate; largest leaves usually less than 13 mm long; leaf margins mostly toothed near apex and along longest side; seeds 1–1.2 mm long, about half as wide as long, ashy white to brownish at maturity, with 4–6 transverse ridges ..... **Euphorbia abramsiana**

17. Plants mostly erect to ascending; largest leaves usually over 13 mm long; leaf margins evenly serrated all around; seeds 1.3–1.4 mm long, more than half as wide as long, usually blackish or dark gray at maturity, with 3 or fewer transverse ridges .....**Euphorbia hyssopifolia**

Euphorbia abramsiana L.C. Wheeler
[*Chamaesyce abramsiana* (L.C. Wheeler) Koutnik]
Desert sandmat, Abrams' spurge; *golondrina.* Figures 11A, 12.

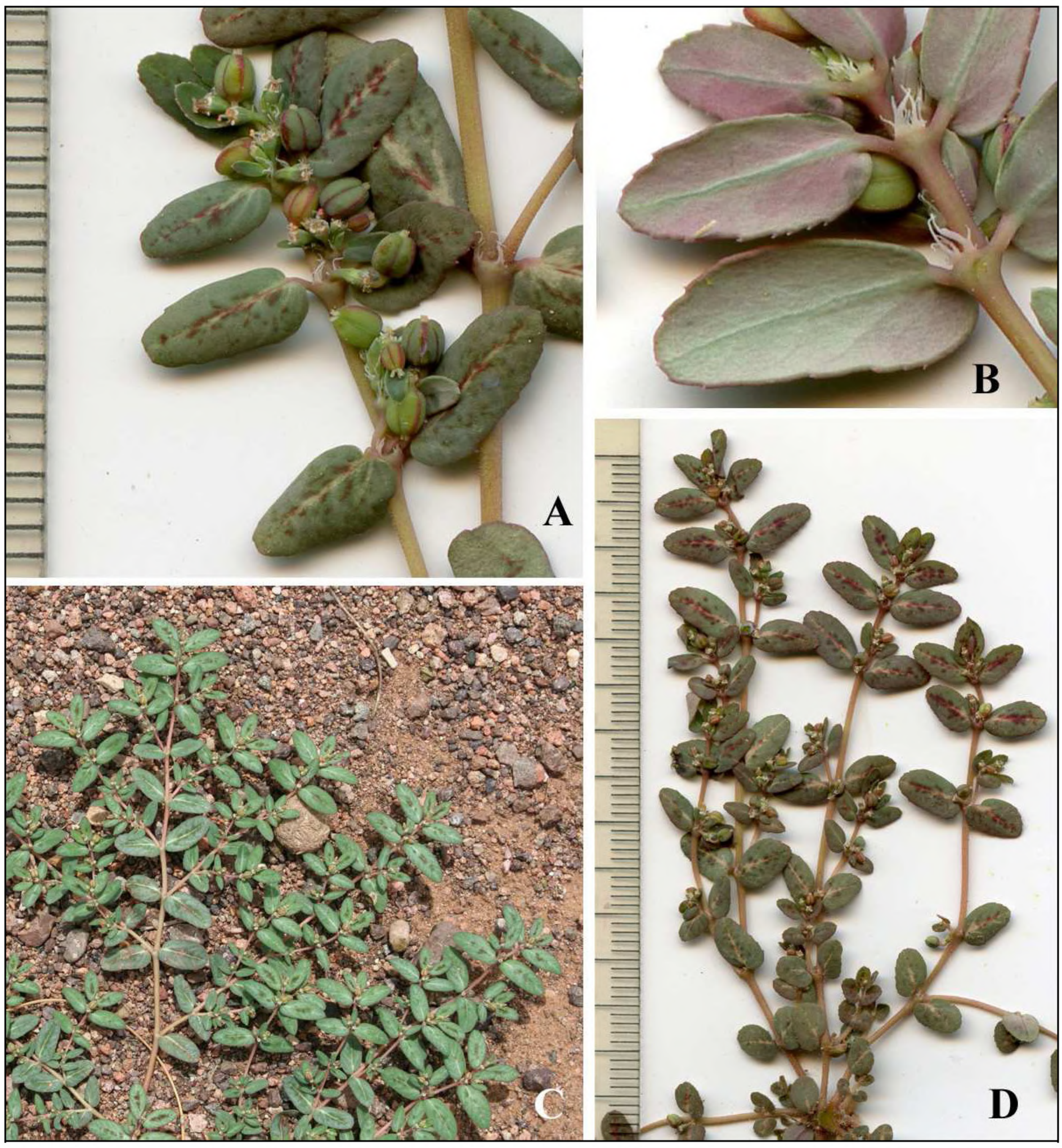

Figure 12. *Euphorbia abramsiana.* (A & B) Why, 31 Jul 2014. (C) Near Bates Well, 16 Aug 2006. (D) Chico Shuni Wash near Chico Shuni Village, 5 Aug 2014.

Small, warm-weather ephemerals, sometimes still present in December, often forming prostrate mats with reddish-brown herbage in dry, open habitats, but upright to spreading and green among dense vegetation and in shaded places. Herbage with short white hairs usually on youngest growth, at the base of the plant, and on at least proximal portions of stems; the distal parts of the stems and herbage often glabrate or essentially glabrous, or the entire plant rarely glabrate (thus part of the plant may be pubescent and part may be glabrate or glabrous). Leaf blades 2.5–12 (14) mm long, elliptic to oblong, usually toothed near apex and along longest side, red-brown or green with one or more reddish botches near the center. The leaf margins tend to curl when drought stressed, giving the appearance of entire margins. Stipules white, fringed or ciliate, separate or narrowly fused at base. Cyathia 0.4–0.5 mm wide, the involucral glands dot-like (round or nearly so), 0.1–0.15 (0.2) mm wide, the appendages absent or to 0.2 mm wide, white or pink. Capsules glabrous (or essentially so), often bright green with red stripes at the angles and furrows. Seeds 1–1.2 mm long, about half as wide as long, ashy grayish-white to tan, with 4–6 transverse ridges; mucilaginous when moistened; the seeds, like various other Hypericifolia species, look like mealy bugs (Pseudococcidae) or beetle larvae.

Widespread across the flora area in many habitats and soils, including clay soils in playas and fine alluvium along washes to gravelly or rocky soils to desert pavement. Often growing with *E. polycarpa* and *E. micromera*. Seasonally common in many areas, including the large Cabeza Prieta playas near the Mexican border.

Southern Arizona to southern Trans-Pecos, Texas (along the Rio Grande in Big Bend National Park and Big Bend Ranch State Park), Sonora, Sinaloa, southeastern California, and much of the Baja California Peninsula.

OP: Aguajita, 13 Sep 1986, *Felger 86-277*. Near Gachado junction, *Wirt 25 Jul 1990*. Ajo Mountain Drive, 2 mi from Hwy 85, 530 m, xeroriparian, with *Euphorbia pediculifera, E. setiloba*, 12 Sep 2014, *Rutman 20140912-2*. 1.5 mi W of State Route 85 and 0.15 mi S of Armenta Ranch Rd, 30 Sep 2006, *Rutman 20060930-3*.

CP: Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-658* (ARIZ, ASU). San Cristobal Wash, 14 Sep 1992, *Felger 92-684*. Las Playas, 28 Nov 2001, *Felger 01-577*.

TA: Coyote Water, 25 Oct 2004, *Felger 04-44*. Coyote Wash at Camino del Diablo, 25 Oct 2004, *Felger 04-68*.

Euphorbia albomarginata Torrey & A. Gray
[*Chamaesyce albomarginata* (Torrey & A. Gray) Small]
Rattlesnake weed; *golondrina*. Figures 11B, 13.

Herbaceous perennials from deeply set, thickened roots, and also flowering in the first season; stems prostrate-creeping, rooting at nodes, often locally carpeting the ground. Roots relatively large and rough, with adventitious roots at nodes, or where there are not roots on the nodes there are almost always (except in very young stems) bumps below the stipule representing the structure that can or will form adventitious roots. Plants glabrous. Leaf blades 2–8 mm long, broadly ovate to orbicular, often with a red blotch in the middle, the margins entire and often with a narrow white edge (hence the specific name). Stipules relatively large and conspicuous, usually white, united into a triangular scale with a fringed margin. Cyathia solitary at nodes, the involucres more than 1 mm wide. Glands (0.3) 0.5 mm or more wide (the smaller sizes might not be fully formed) and oval. Petaloid appendages white and conspicuous, wider and longer than the glands. Stamens (10) 15–30 per cyathium. Seeds 0.9–1.4 mm long, the dorsal side with a low ridge crest, moderately flattened on either side of the ridge, and excavated on both sides of the septum on the ventral surface; mucilaginous when moistened. Growing and flowering at various seasons.

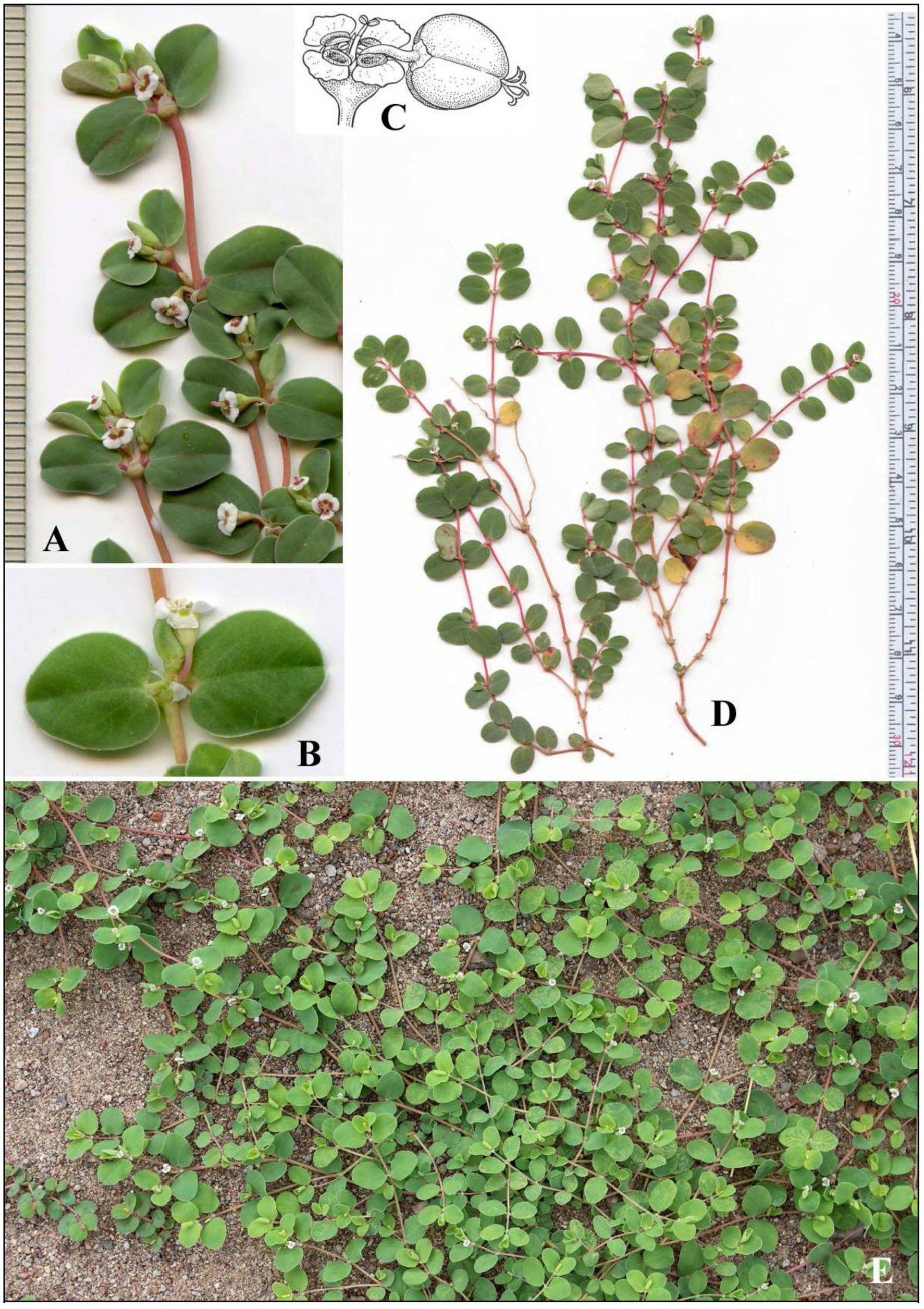

Figure 13. *Euphorbia albomarginata*. (A) Wash bed, Why, 3 Sep 2014. (B) Roadside, Hwy 86 E of Why, 11 Sep 2014. (C) By Lucretia Breazeale Hamilton. (D) Cuerda de Leña near N boundary of Organ Pipe, 12 Sep 2008. (E) Roadside, Hwy 86 east of Why, 1 Aug 2014.

Locally common in poorly drained, fine-textured, and often sandy-silty soils; playas, dirt tanks, washes and canyon bottoms, and roadside ditches. Widely scattered across the lowlands of much of the flora area.

Widespread in western North America.

OP: Bates Well, *Nichol 26 Apr 1939*. Senita Basin, *Warren 11 Aug 1975*. Growler Canyon, E. of Bates Well, sandy soil, 19 Mar 1975, *Lehto L18318* (ASU). Puerto Blanco Drive, 7.9 by road W of Visitor Center, 16 Oct 1977, *Bowers 893*.

CP: S19, T15S, R12W, sand, 5 Apr 1979, *Lehto L23475* (ASU). Las Playas, 31 Jan 1992, *Felger 92-16*. Jose Juan Tank, 12 Jun 1992, *Felger 92-569*-C. Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-659*. San Cristobal Wash, 14 Sep 1992, *Felger 92-687*.

The *Euphorbia serpens* species complex includes *E. serpens*, its sister species *E. albomarginata*, and five other species that appear to involve *E. serpens* as one of their parents. These species form a complex inferred to have highly reticulate evolutionary relationships (Yang & Berry 2011: 1498). *Euphorbia serpens* Kunth, a worldwide and often weedy spurge, resembles and is often confused with *E. albomarginata*. Surprisingly, we have not found any verifiable specimens of *E. serpens* from Arizona: specimens from Arizona previously labeled as *E. serpens* have turned out to be *E. albomarginata*. *E. serpens* is annual, although it sometimes can overwinter; unlike *E. albomarginata*, the roots are smooth and not knotty. The leaves of *E. albomarginata* usually are larger and more circular than those of *E. serpens*, but some *E. albomarginata* specimens have smaller leaves than those of most *E. serpens* specimens. *E. serpens* has smaller involucres and smaller glands, and fewer stamens, which is the most reliable key character. They can be distinguished as follows:

1. Perennials; involucres usually more than 1 mm wide, petaloid appendages usually conspicuous; stamens (10) 5–30 per cyathium ..... **E. albomarginata**
1. Annuals; involucres 0.6 to less than 1.0 mm wide; appendages inconspicuous; stamens (2) 3–5 per cyathium ..... **E. serpens**

Euphorbia arizonica Engelmann
[*Chamaesyce arizonica* (Engelmann) Arthur]
Arizona spurge; *golondrina*. Figures 11C, 14.

Herbaceous perennials, often mound-shaped, and also flowering in the first season. Plants, including cyathia and capsules, conspicuously pubescent, the hairs glandular and slightly enlarged at the tip with several septa between red bead-like segments. Herbage often reddish, especially when drought- or cold-stressed. Leaves short petioled, the blades 1.2–8.5 mm long, mostly broadly ovate, or nearly orbicular or oblong, the margins entire; stipules minute (often not readily apparent). Involucres narrowly urceolate (urn shaped), taller than wide, 0.8–1.6 mm long, slightly narrowed at apex just below the glands, pink to reddish; appendages petal-like, conspicuous, wider than the glands, white, becoming dark pink with age, the margins entire or shallowly lobed. Seeds 0.9–1.1 mm long, chunky, transversely ridged, mucilaginous when wet.

Rocky habitats and canyons in the Ajo Mountains and probably elsewhere in Organ Pipe.

Southern California to west Texas, south to Baja California Sur, southern Sonora, and Durango.

The cyathia are similar to those of *E. setiloba* except larger and the petaloid appendages entire or shallowly lobed rather than laciniate-margined. The minute stipules, reddish herbage,

glandular pubescence, and conspicuous bright white or pink appendages serve to distinguish *E. arizonica*. The reduction of stipules is an unusual feature among the *Hypericifoliae* and one shared with *E. setiloba*. Taylor reports, "In both species the stipules are reduced to a small flap over the node, the same color as the stem, and appressed to the point of being nearly invisible. They range from whitish to purple to dark purple. And, on some, no matter how hard I tried, I was unable to make them out through the dense glandular hairs. The best specimens to see them on are the ones that are etiolated. If you can't find one that is etiolated, try the very apex of the stems on both sides. In *E. arizonica* the flap is pretty much always present." The seeds of *E. arizonica* are similar to those of *E. abramsiana* but differ in being slightly smaller and having deeper and more irregular furrows.

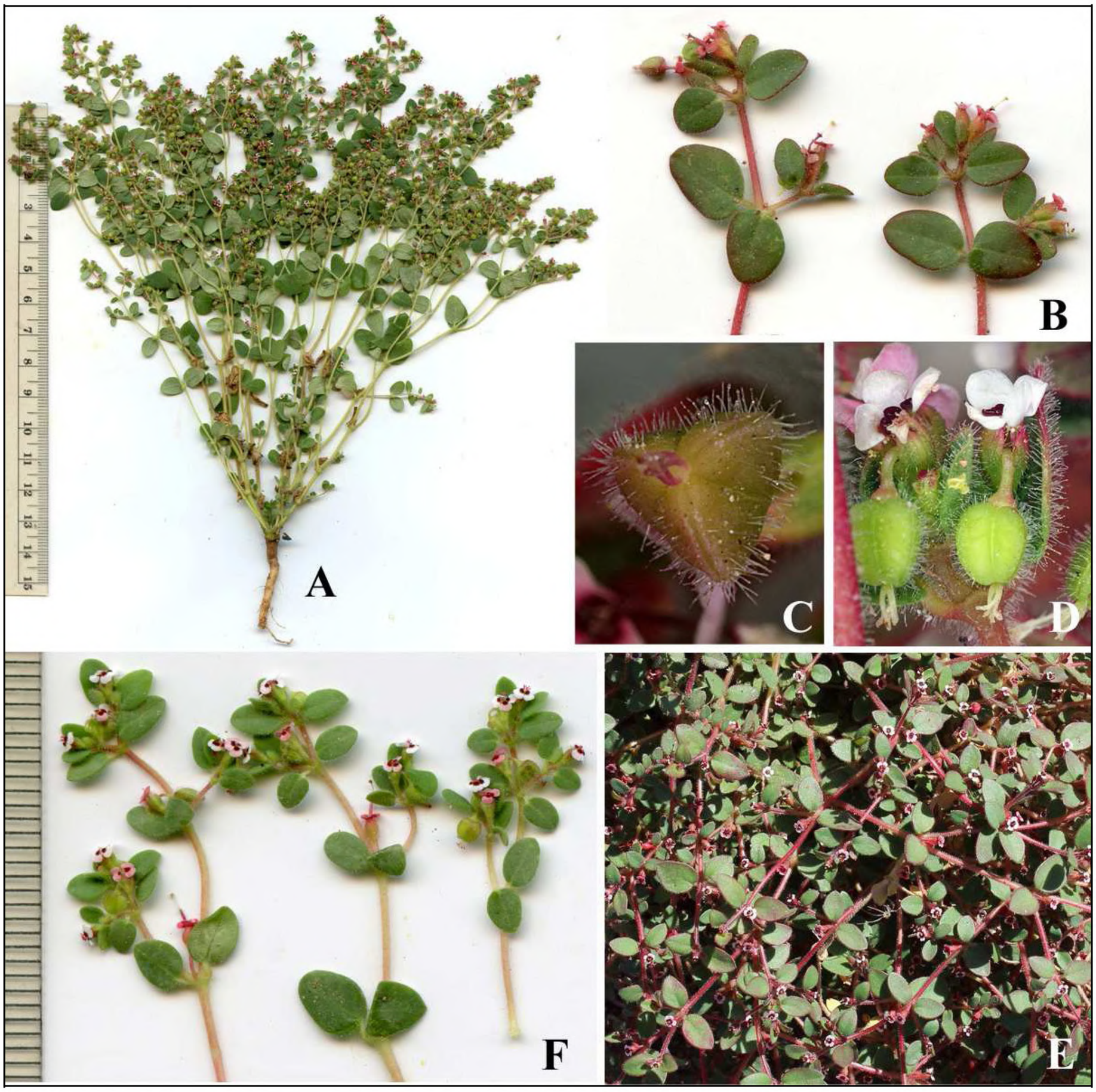

Figure 14. *Euphorbia arizonica*. (A) Bull Pasture Trail, 19 Sep 2014. (B & F) Alamo Wash near Hwy 85 bridge, 2 Aug 2014. (C & D) Billings Vista, Burro Mts, Grant Co., NM, 20 Jul 2009, photos by Russell Kleinman (gilaflora.com). (E) Alamo Wash near confluence with Tillotson Wash, 2 Nov 2013.

OP: Alamo Canyon: *Nichol 14 Mar 1939*; Wash E of Cement Tank, 10 Oct 1978, *Sutherland 4*; 16 Feb 1979, *McLaughlin 1934*. Bull Pasture Trail, 5 Nov 1977, *Bowers 948*. Estes Canyon, 2500 ft, 11 Apr

1978, *Bowers 1238* (ORPI). Arch Canyon, immediately below the arch, 900 m, 2 Dec 1990, *Felger 90-527*.

Euphorbia capitellata Engelmann
[*Chamaesyce capitellata* (Engelmann) Millspaugh] Figure 15.

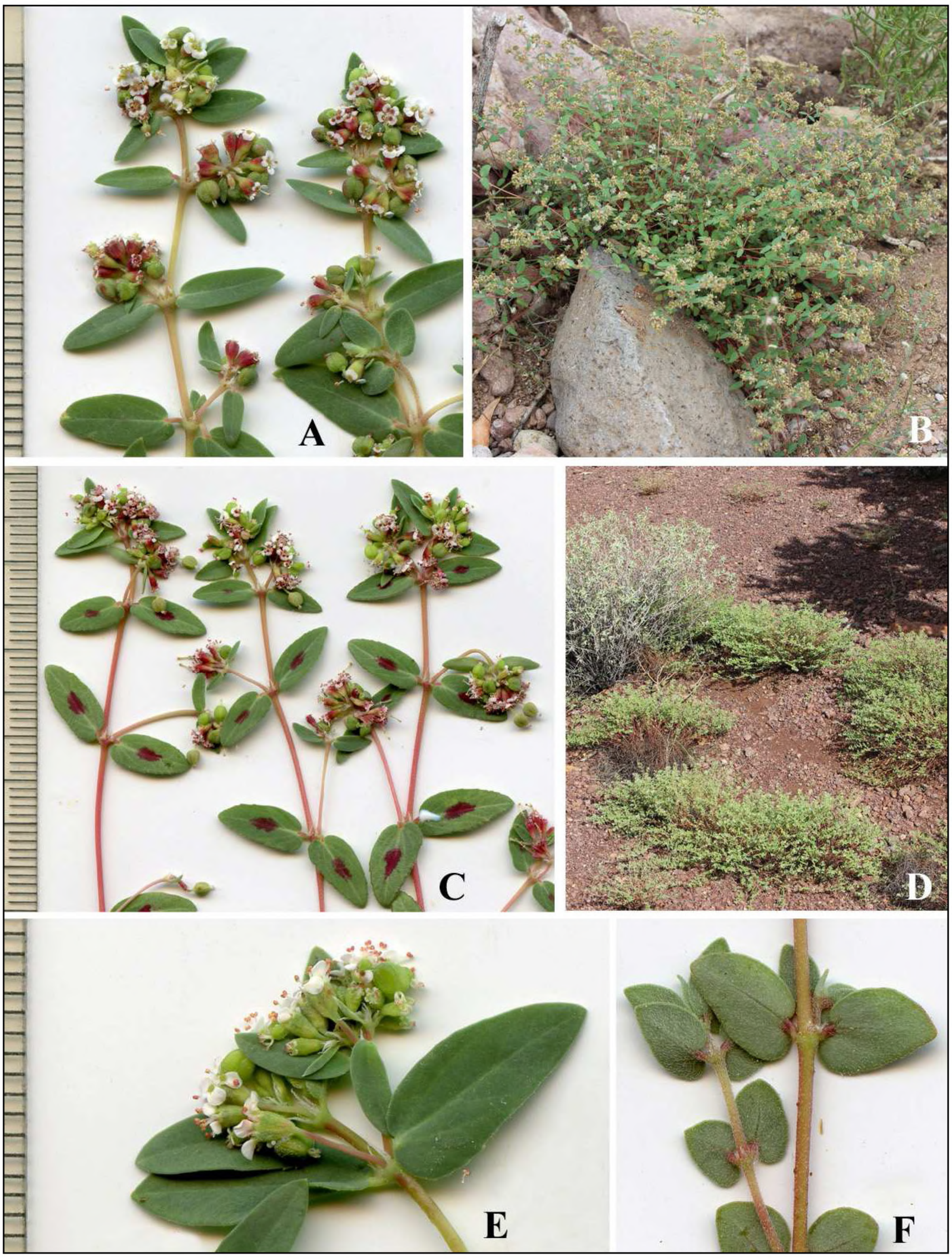

Figure 15. *Euphorbia capitellata*. Alamo Wash at Hwy 85 bridge: (A–C) 2 Aug 2014; (F) 2 Aug 2014. (D) Estes Canyon along trail to Bull Pasture, 8 Sep 2014. (E) Wash crossing Hwy 85 at mile 66.5, 0.5 mi S of Alamo Wash, 2 Aug 2014.

Herbaceous perennials with a stout tap root. Herbage pubescent, glabrate, or glabrous especially with age. Leaf blades mostly 4–22 mm long, green, often with reddish blotches in the middle, markedly asymmetrical, ovate to linear lanceolate, often falcate, serrate along the lower margins, or remotely serrate, or entire; leaves becoming reddish when drought stressed. Stipules narrow, ciliate, and separate. Cyathia in dense clusters at stem tips; petaloid appendages white to sometimes pink and much wider than the glands. Ovaries and capsules pubescent, glabrate, or glabrous. Seeds 1.2–1.4 mm long, at first brown, becoming grayish-white, and sharply angled with low transverse ridges; highly mucilaginous when wet. Flowering at any season except during extreme drought.

Gravelly washes and lower slopes in the Ajo and Diablo mountains.

Arizona to Texas, and Sonora to Coahuila, Durango, and the Baja California Peninsula.

OP: Cement Tank [Alamo Canyon], *McDougall 14 Apr 1941*. Rocky slopes 6.7 mi by road NE of Visitor Center along Ajo Mt Drive, 2000 ft, 5 Nov 1977, *Bowers 922* (ORPI). Estes Canyon picnic site, *Beale 15 Feb 1987* (ORPI). Low- to mid-bajada of the Ajo Mts, 2114 ft, abundant in the sand and gravel drainage bed, 2 Apr 2003, *Rutman 2003-448*.

Euphorbia florida Engelmann
[*Chamaesyce florida* (Engelmann) Millspaugh] Figures 9, 16.

Warm-weather annuals, to 50 cm tall, glabrous, the stems erect to ascending, and especially the upper stems very slender. Leaf blades notably slender, linear to sometimes narrowly lanceolate, 5–50 × 0.5–2.5 (5.5) mm; the margins minutely toothed and becoming revolute in age. Stipules 1–2 mm long, slender and separate, usually fringed. Petaloid appendages conspicuous, larger than the glands, white and often becoming pink with age. Seeds 1.7–2 mm long, chunky, grayish white, the faces relatively smooth with 1–few low transverse ridges; mucilaginous when wet.

Major washes, sandy flats, and canyon bottoms. Widely scattered across much of Organ Pipe in the Arizona Upland areas and major washes on the east side of Cabeza Prieta; often locally common, such as in washes and grassy area in the north-central part of Organ Pipe.

Arizona to Jalisco and Chihuahua.

OP: Alamo Canyon, bottom, 28 Aug 1943, *Clark 10943* (ORPI). Near Dripping Springs, *Galiano 21 Aug 1986* (ORPI). 1.5 mi W of State Rte 85, and 0.15 mi S of Armenta Ranch Road, 30 Sep 2006, *Rutman 10060830-1* . 0.8 km E of summit of Twin Peaks, 1740 ft, 1 Aug 1990, *Baker 7884* (ASU, ORPI). N end of Bates Mts, 437 m, 11 Sep 2013, *Rutman 20130911-1*. Arch Canyon, N of the arch, *Rutman 12 Sep 2014*.
CP: Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-660*.

Euphorbia hyssopifolia Linnaeus
[*Chamaesyce hyssopifolia* (Linnaeus) Small]
Hyssop spurge. Figure 17.

Warm-weather ephemerals, glabrous or sometimes sparsely pubescent, often with an erect main axis or several ascending major branches, to ca. 60 cm tall. Leaves 4–20 (30) mm long (larger leaves usually 13 or more mm long), lanceolate to oblong, sometimes with a red blotch or blotches in the center, the margins evenly serrated. Stipules ca. 1 mm long, triangular and moderately fringed, and separate or fused basally. Cyathia 0.4–0.9 mm wide, the involucral glands 0.2–0.4 mm wide, oval, pink to maroon; petaloid appendages absent or 0.3–0.6 mm wide, broader than long, white or pink, darkening with age. Seeds 1.3–1.4 × 1 mm, corpulently ovoid, at first grayish and usually becoming blackish, the angles rounded, and with a few shallow transverse depressions; mucilaginous when wet, even when 1200 years old, and adhering tenaciously after drying.

Widely scattered in Organ Pipe and the east side of Cabeza Prieta. Bajadas, canyons, large washes, rocky slopes, and mountains. It has been the Ajo Mountains for at least 1200 years. The fossil seeds produced mucilage when immersed in water.

Arizona to southeastern United States and South America; also adventive in the Old World.

OP: Alamo Canyon, ¼ mi SE of corral, along main wash, *Wirt 27 Jul 1990*. Bull Pasture, *Wirt 13 Aug 1990* (ORPI). Growler Valley, near intersection of Bates Well Road and historic Palo Verde Camp Road, 8 Oct 2006, *Rutman 20061008-7*. Saddle between Arch and Boulder canyons, 26 Oct 2003, *Rutman 20031026-18*. †Alamo Canyon, capsule with 3 seeds, 1150 ybp.

CP: Daniels Arroyo, 26 Sep 1992, *Harlan 309*. Growler Valley, San Cristobal Wash where the Camino del Diablo/Bates Well Road crosses the wash, 318 m, 26 Sep 2013, *Rutman 20130926-6*.

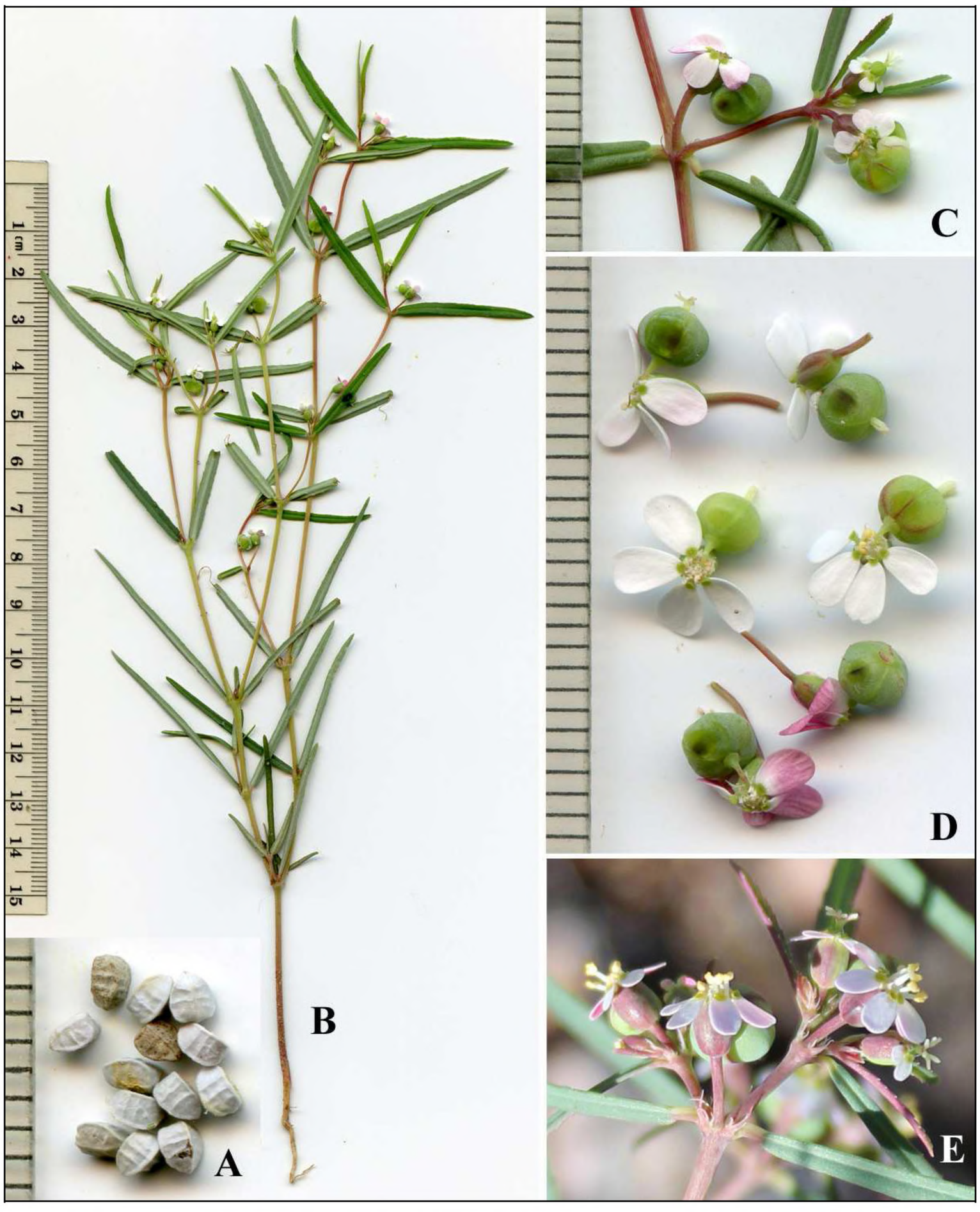

Figure 16. *Euphorbia florida*. (A) Diablo Mts, N end of Ajo Mountain Drive, 30 Sep 2014. (B) Cuerda de Leña, 4 Aug 2014. (C & D) Roadside ditch, Hwy 86 between Why and Pisinimo, Pima Co., 23 Aug 2014. (E) Wash crossing the northern Ajo Mountain Drive, Diablo Mts, 12 Sep 2013.

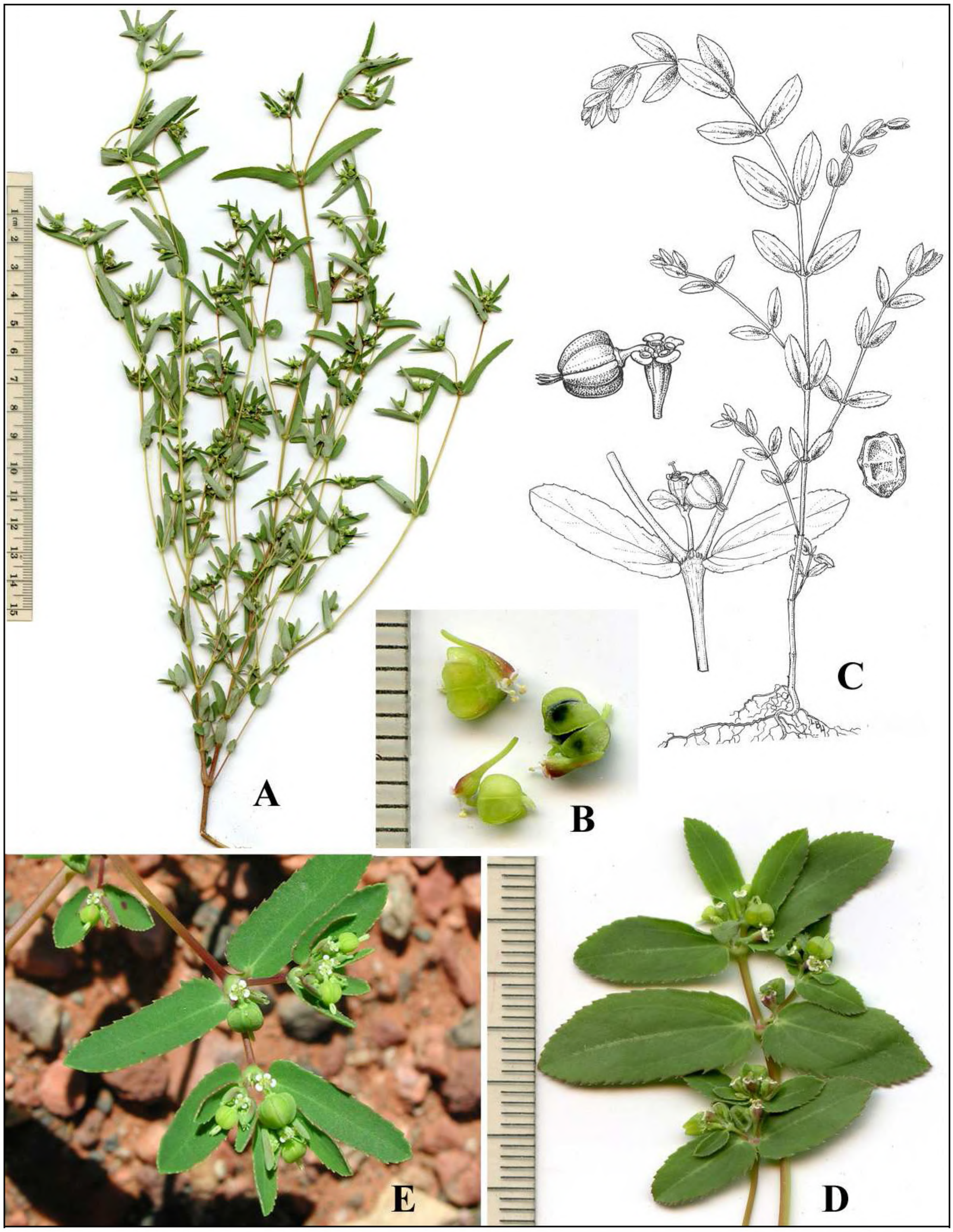

Figure 17. *Euphorbia hyssopifolia*. (A) Estes Wash near Ajo Mountain Drive, 26 Aug 2014. Roadside ditch, Hwy 86 between Why and Pisinimo: (B) 23 Aug 2014; (D) 1 Aug 2014. (C) By Lucretia Breazeale Hamilton. (E) Sedona, Yavapai Co., 15 Aug 2011, photo by Max Licher (SEINet).

†Euphorbia melanadenia Torrey
[*Chamaesyce melanadenia* (Torrey) Millspaugh]
Golondrina. Figure 18.

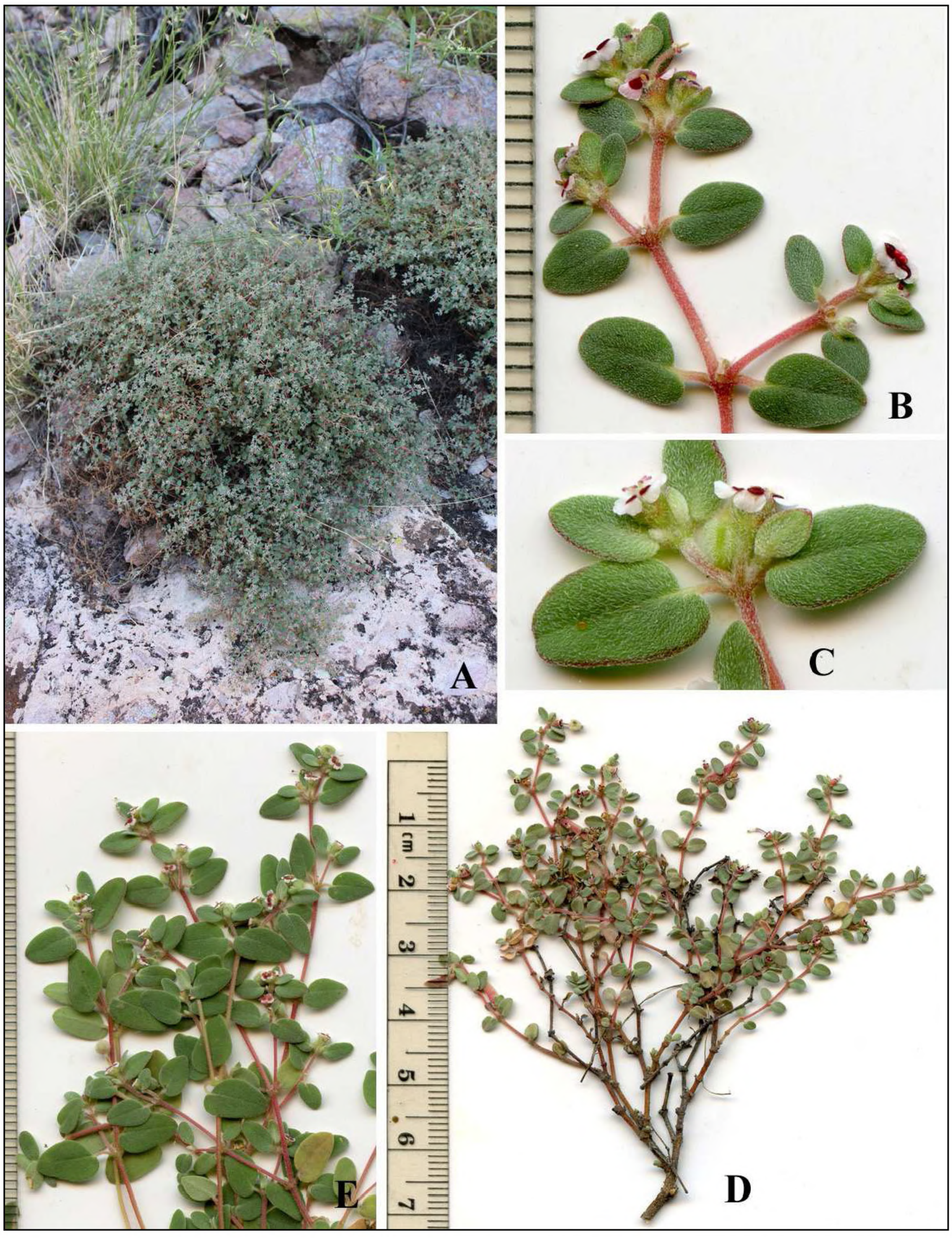

Figure 18. *Euphorbia melanadenia*. (A, C, & D) Arch Canyon, 12 Sep 2014. (B) Wash crossing N end of Ajo Mountain Drive, 26 Aug 2014. (E) Bull Pasture Trail, 8 Sep 2014.

Small, densely branched perennial herbs, new growth often tomentose, with grayish appressed hairs and sometimes becoming glabrate with age, the herbage usually purplish-gray. Leaf blades 3–8 mm long (to 16 mm long on well-watered, vigorous new growth of first season plants), ovate to lanceolate, the margins entire. Stipules ca. 1 mm long, slender and separate on the dorsal side of the stem, those on the ventral side united basally. Cyathia broad with dark maroon glands (oval, wider than long) and with conspicuous white petaloid appendages (often not present on young, developing cyathia), usually broader (often much broader) than the glands and often notched at the tip; ovaries densely pubescent, the capsules pubescent. Seeds 1.1–1.5 mm long, elongated, and smooth to faintly wrinkled, and mucilaginous. This spurge usually is readily recognized by the grayish or reddish-gray herbage, appressed hairs, and showy petaloid appendages.

Ajo Mountains and probably the Diablo Mountains; canyon bottoms to rocky slopes from low to high elevations, often on thin soils or bedrock growing among *Selaginella*. A leaf from a packrat midden more than 8000 years old had intact pubescence allowing identification.

Central and southern Arizona and northern Sonora, and disjunct in southern California, Baja California, and Baja California Sur.

OP: Alamo Canyon: *Tinkham 19 Apr 1942*; 2 Feb 1946, bed of canyon, *Goodding 7-46*; bed of wash, 9 Mar 1946, *Goodding 10-46*. Bull Pasture Trail, ca. 3000 ft, *Bezy 25 Oct 1964*. Middle bajada, Ajo Mts, 2 Apr 2003, *Rutman 2003-448*. Trail from The Cones to Mount Ajo, 3940 ft, 10 Apr 2005, *Felger 05-263*. †Alamo Canyon, leaf, 8130 ybp.

Euphorbia micromera Boissier
[*Chamaesyce micromera* (Boissier) Wooton & Standley]
Golondrina. Figure 19.

Small herbaceous perennials or mostly non-seasonal ephemerals, resembling *E. polycarpa*. Glabrous or often hairy, especially the capsules and new growth. Leaf blades 1.2–5 mm long (larger leaves often few in number and on larger stems near the center or base of the plant), mostly broadly ovate to oblong, the margins entire. Stipules linear and ciliate; fused basally on the ventral side, separate on the dorsal side. Involucre usually less than 1 mm wide, the glands 0.12–0.25 mm wide, dot-like, rounded, maroon, without petaloid appendages. Stamens 2–5 per cyathium. Capsules often with red stripes at the angles and furrows. Seeds 0.9–1.0 mm long, resembling those of *E. polycarpa,* mucilaginous when wet.

Common in many habitats including washes, plains, bajadas, and rocky slopes. Widespread in Organ Pipe and Cabeza Prieta.

Southeastern California to Utah and west Texas, Baja California, northern Sonora, and the Chihuahuan Desert in north-central Mexico.

There is little to distinguish *E. micromera* from *E. polycarpa* except the consistent absence of petaloid appendages on the cyathia; the smaller, rounded, dot-like rather than oval glands; and fewer stamens. Although most *Chamaesyce* have distinctive seeds, those of *E. micromera* and *E. polycarpa* appear identical. *E. micromera* has been reported to be annual (ephemeral) and *E. polycarpa* perennial, but both occur as ephemerals/annuals or perennials. *E. micromera* ranges farther north than does *E. polycarpa*, and *E. polycarpa* ranges farther south than does *E. micromera*. *E. micromera* tends to be more numerous in relatively more arid habitats, whereas *E. polycarpa* tends to be more numerous in somewhat less arid habitats. Especially in arid situations, *E. polycarpa* may produce plants lacking petaloid appendages, and the glands may be smaller than usual, but they are oval, whereas those of *E. micromera* are round and dot-like. *E. micromera* produces 2–5 stamens per

involucre while *E. polycarpa* may have 15–32 stamens per involucre. Although counting the exact number of stamens may be difficult, you usually can find the approximate number: Even after the anthers fall away, the male flower stalks (pedicels and filaments) and/or their stubs usually remain and can be seen with magnification.

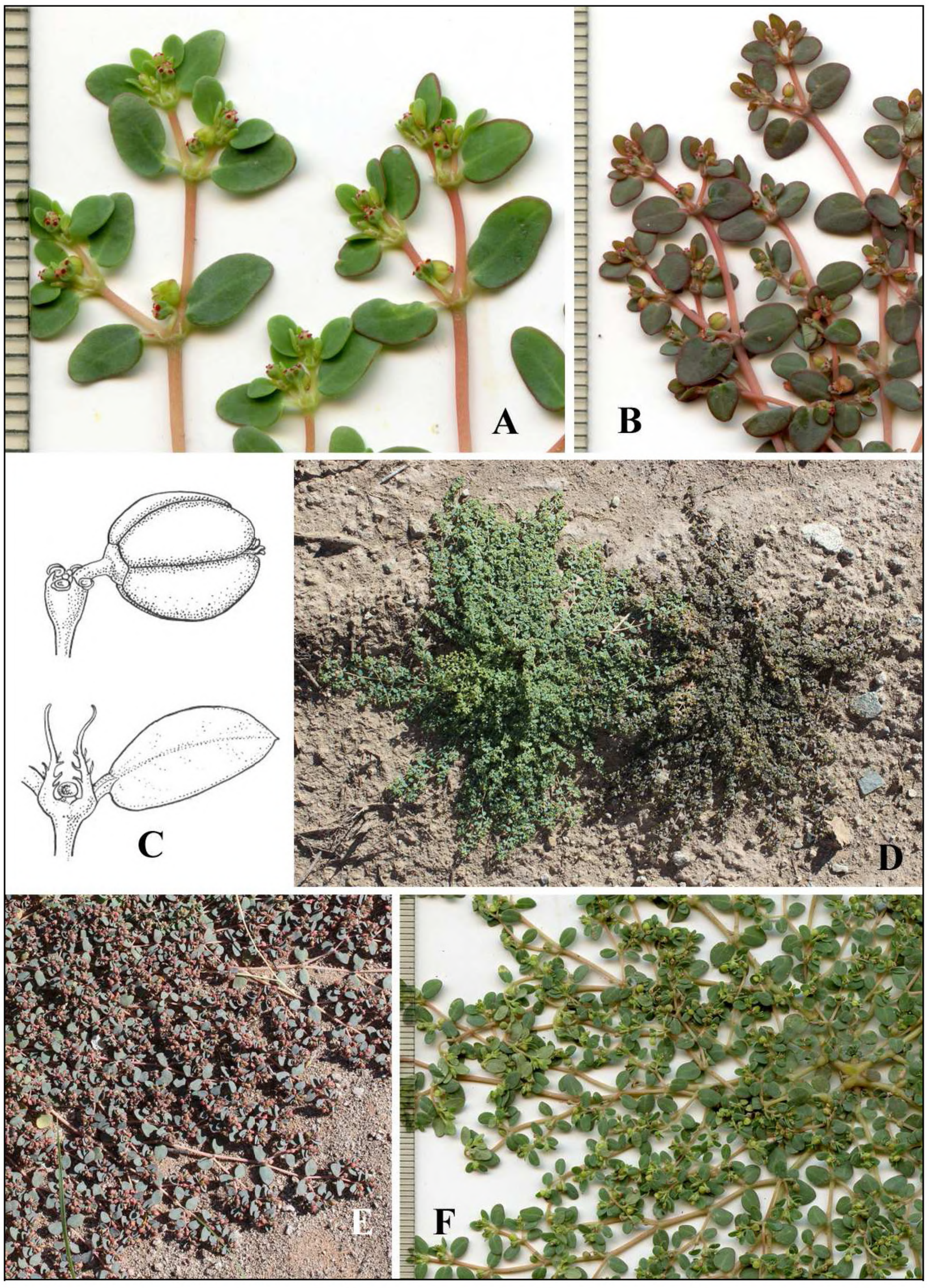

Figure 19. *Euphorbia micromera.* (A & F) Alamo Wash near Hwy 85 bridge, 9 Aug 2014. (B) Kuakatch Wash near Hwy 85, 11 Aug 2014. (C) Cyathium with capsule (above) and a node with stipules, by Lucretia Breazeale Hamilton. (D & E) Two color morphs, Knucklehead Wash, base of Childs Mountain, 5 Sep 2014.

Plants of *E. parishii* Greene, known from deserts in southeastern California, resemble both *E. micromera* and *E. polycarpa*. However, Yang and Berry (2012) show that *E. parishii* is not especially close to them phylogenetically. Like *E. micromera*, *E. parishii* lacks petaloid appendages but is more like *E. polycarpa* in having glands 0.5 mm wide. *E. parishii* is reliably distinguished by having 40–50 stamens per cyathium.

OP: Armenta Well, *Warren 16 Nov 1974*. Aguajita, 13 Sep 1986, *Felger 86-294*. Armenta site, 2 mi W of Hwy 85, *Wirt 8 Sep 1990*. 1.5 mi W of State Rte 85 and S of Armenta Ranch Road, 30 Sep 2006, *Rutman 20060930-9*.

CP: Christmas Pass, 14 Apr 1992, *Harlan 276* (CAB). Packrat Hill, 25 Sep 1992, *Harlan 300*. Little Ajo Mts, Copper Canyon at Charlie Bell Road, xeroriparian, 24 Aug 2014, *Rutman 20140824-19*.

†Euphorbia micromera and/or E. polycarpa

One or both of these species was in the Tinajas Altas Region more than 10,000 years ago.

TA: †Butler Mts, capsules, seeds, 8160 & 10,360 ybp.

Euphorbia pediculifera Engelmann var. **pediculifera**
[*Chamaesyce pediculifera* (Engelmann) Rose & Standley var. *pediculifera*]
Louse spurge; *golondrina*. Figures 11D, 20.

Non-seasonal ephemerals to short-lived perennials, spreading to prostrate with age. Young herbage, capsules, and cyathia densely pubescent, the hairs relatively thick, short, white, and appressed to spreading, the herbage sometimes becoming glabrate with age. Herbage often reddish brown to gray-brown, especially in dry seasons. Leaf blades usually at least twice as long as wide, 5.5–15.5 mm long, ovate to obovate or oblong, the margins entire or sometimes with a few small, irregular teeth. Stipules on dorsal side of stem slender and separate, those on the ventral side united basally. Cyathia 1.2–1.5 mm wide, the glands usually maroon (or yellowish with summer rains), oval, 0.6–0.9 mm wide, the appendages conspicuous, wider and longer than the glands, sometimes 2–2.5 × 1–1.2 mm, white, becoming pink with age. Capsules sometimes with red stripes at the angles and furrows. Seeds 1–1.2 mm long, chunky, encircled by conspicuous transverse ridges, the dorsal ridge rounded and somewhat flattened; mucilaginous when wet.

Organ Pipe and at least the eastern half of Cabeza Prieta; widespread and common in many habitats including sandy gravelly washes, plains, and rocky slopes.

Sonoran Desert in California and Arizona, and southward to Sinaloa and the Cape Region of Baja California Sur. Another variety occurs in the Guaymas Region in Sonora.

OP: Quitobaquito: 30 Jan 1894, *Mearns 2746* (US); 13 Sep 1986, *Felger 86-278*. Bates Well, 16 Nov 1939, *Harbison 26146*. Twin Peaks, 2 Mar 1985, *Van Devender 85-5*.

CP: 14 mi W of Papago Well, 18 Feb 1979, *McLaughlin 1959*. Pinta Sands, *Mathes 21 Mar 1992* (ASC). Agua Dulce Spring, 14 Sep 1992, *Felger 92-733*. Charlie Bell Road near E Refuge boundary, 25 Feb 1993, *Felger 93-55*.

Euphorbia platysperma Engelmann ex S. Watson
[*Chamaesyce platysperma* (Engelmann ex S. Watson) Shinners]
Gran Desierto dune spurge. Figure 21.

Non-seasonal annuals to herbaceous perennials, with deeply buried roots and often dune-buried stems, forming loose, spreading mounds often 0.5–1+ m across. Plants glabrous; stems slender, flexible, pale orange, arching or ascending, becoming semi-prostrate with age, with sand adhering to the glandular-sticky buried portions of the stems and forming a sand jacket. Leaf blades often 5–16 × 2.2–7.2 mm, elliptic to oblong or obovate, relatively thin, the midrib prominent, the

margins entire. Stipules narrowly triangular and separate. Cyathia on prominent peduncles, solitary in the leaf axils, 1.2–1.8 mm wide, and yellow-green; glands 0.5–0.9 mm wide, yellowish-green, and darker and more prominent than the appendages; the appendages yellowish and shorter than the glands. Stamens ±50. Seeds 2.4 × 1.4 mm, slightly incurved near the tip, the dorsal side smooth, with or without a prominent medial ridge, the inner face flattened and smooth on either side of a prominent medial ridge; seeds not mucilaginous. Flowering in nearby Sonora recorded from October to May.

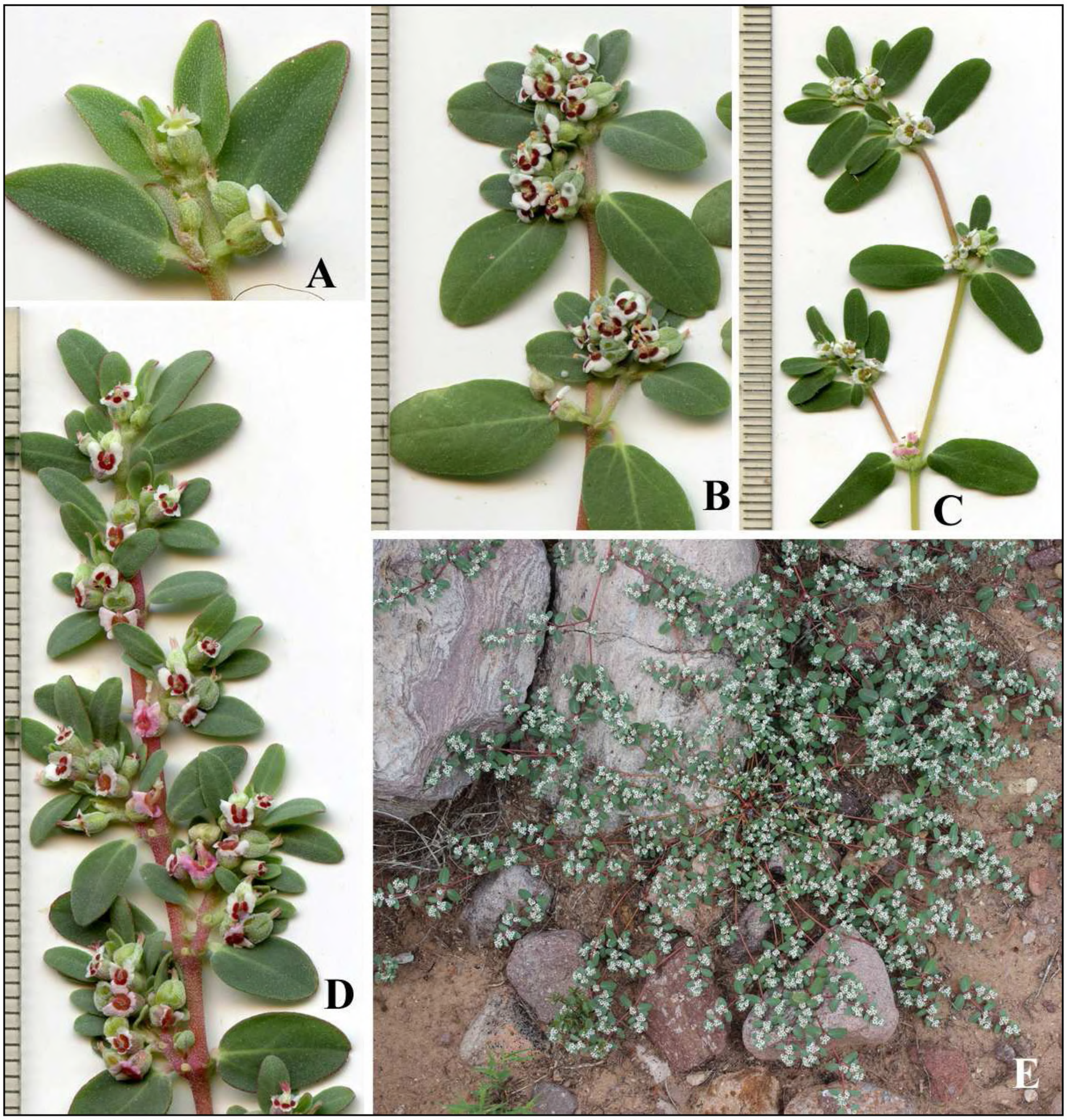

Figure 20. *Euphorbia pediculifera* var. *pediculifera*. (A) Cuerda de Leña near N boundary of Organ Pipe, 4 Aug 2014. (B) Wash at Hwy 85 mile 66.5, 0.5 mi S of Alamo Wash, 3 Sep 2013. (C) Kuakatch Wash at Hwy 85, 7 Sep 2014. (D) Wash draining Chuckwalla Hills, 2 mi from Hwy 85 on Ajo Mountain Drive, 12 Sep 2014. (E) Estes Canyon, 19 Sep 2014.

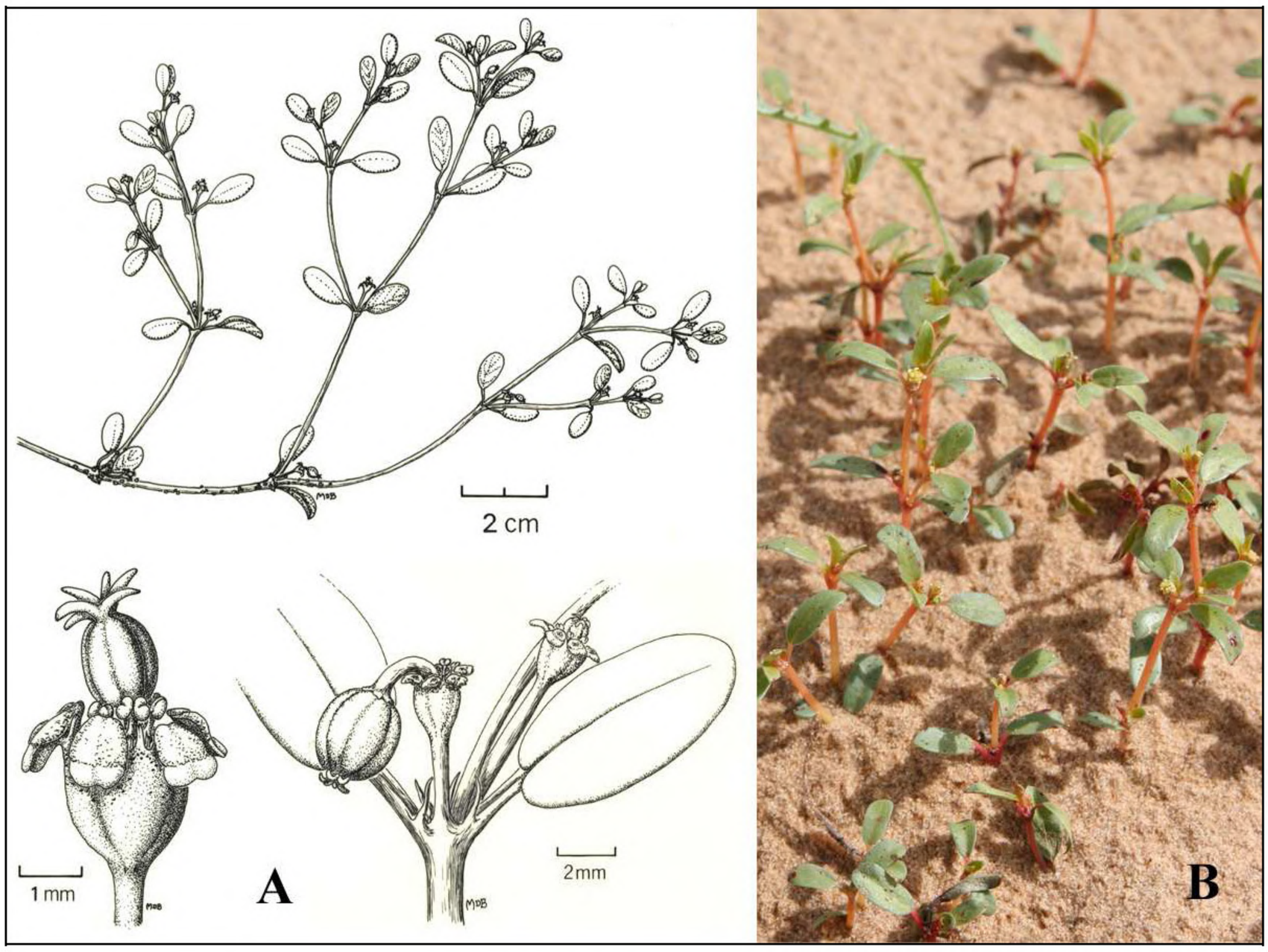

Figure 21. *Euphorbia platysperma*. (A) By Marlo Buchmann (from Felger 1980, 2000). (B) Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 20 Feb 2005.

The main population occurs on dunes and adjacent windblown sands of the Gran Desierto of northwestern Sonora (Felger 2000). It scarcely extends into Arizona near the southwestern margin of the flora area west of the Tinajas Altas Mountains, and there is one record from Yuma. It is expected in the Pinta Sands of Cabeza Prieta along the Mexican border. Also occasional waifs recorded from windblown sands in southeastern California and northeastern Baja California.

Euphorbia platysperma has the smallest geographic range of any *Chamaesyce* in the Sonoran Desert and is the only member of the Hypericifolia clade in the flora area with non-mucilaginous seeds. A mucilaginous seed coat is also missing in inland Hawaiian species derived from ancestral, coastal species that have mucilaginous seeds (Jordan & Hayden 1992; Yang & Berry 2011). Loss of dispersibility has been shown to be an adaptive feature in many island taxa (e.g., Carlquist 1966, 1980) and the dune and windblown sand habitat of *E. platysperma* is seen as an island-like habitat within the desert. A similar sand-adapted species in Texas and the Midwest, *E. carunculata* Waterfall (sand-dune sandmat), likewise has non-mucilaginous seeds (Nathan Taylor, observation, 5 Feb 2015). *Euphorbia platysperma* and *E. carunculata* are strikingly similar in overall appearance. Both are glabrous and have long internodes, orange stems, seeds with a smooth dorsal surface, and similar appearing branching patterns, leaves, and cyathia. *Euphorbia carunculata*, *E. parryi* Engelmann, and presumably *E. platysperma* are part of a clade of several sand-adapted species in western North America (Yang & Berry 2011). However, *E. parryi* seeds produce moderate amounts of mucilage when wet (Susan Carnahan, observation, 10 Feb 2015).

Yuma Co. (west of TA): Sonora-Arizona border, 25 mi SE of San Luis at U.S. Border marker 198, *Felger 16707*. NW corner of Yuma Dunes, 7.4 km N of Mexico border, *Douglas 876* (ASU).

Euphorbia polycarpa Bentham

[*Chamaesyce polycarpa* (Bentham) Millspaugh. *Euphorbia polycarpa* var. *hirtella* Boissier. *E. intermixta* S. Watson. *E. polycarpa* var. *intermixta* (S. Watson) L.C. Wheeler]
Desert spurge; *golondrina*; vi'ibam. Figures 11E, 22.

Figure 22. *Euphorbia polycarpa*. (A) Roadside ditch, Hwy 86 between Why and Pisinimo, Pima Co., 23 Aug 2014. (B & E) Sand flats 22 mi S of Sonoyta on Mex Hwy 8, Sonora, 7 Sep 2014. (C) Wash crossing Hwy 85 at mile 66.5, 0.5 mi S of Alamo Wash, 3 Sep 2014. (D) Ajo, 25 Jul 2014.

Non-seasonal ephemerals, sometimes reproductive in a few weeks, to small perennials, the taproot well developed. Herbage and capsules glabrous or hairy. Stems prostrate to spreading or ascending, the larger plants much-branched. Leaf blades 1.5–6.8 mm long, broadly ovate or orbicular to oblong, the margins entire. Stipules narrowly triangular, ciliate; ventral side stipules fused basally, the dorsal side stipules separate. Involucral glands 0.3–0.6 mm wide, dark maroon (almost black) or sometimes yellow in summer, oval (wider than long), with conspicuous white appendages, or the appendages sometimes reduced or absent on drought-stressed plants. Stamens 15–32 per cyathium. Seeds 0.8–1.0 mm long, fairly smooth and grayish white, mucilaginous when wet.

This is the most common and widespread euphorbia in the region, ranging from the extremely arid southwestern side of the Tinajas Altas Mountains to the Ajo Mountains; washes, desert plains, bajadas, dunes, and rocky slopes. Sometimes these small plants grow from crevices, such as west-facing rock walls, spreading close to dark lava rock too hot to touch with bare hands in the summer. Seeds placed on damp paper germinated within 6 hours.

Arizona to southern Sonora, southern Nevada, and southern California to Baja California Sur.

Variation in *E. polycarpa* includes a continuum from glabrous or glabrate to densely pubescent herbage and capsules; glabrous or sparsely to densely pubescent plants sometimes occur freely intermixed, and glabrous or pubescent branches sometimes occur on the same plant. The pubescent plants have been called var. *hirtella,* but variation in pubescence shows no geographic segregation, and the type collection of *E. intermixta* appears to be nothing more than first-season plants of *E. polycarpa* (Steinmann & Felger 1997). Wheeler (1936) and Wiggins (1964) recognized several additional varieties, all from the Baja California Peninsula and its adjacent islands, and some of these may be worthy of continued recognition (Steinmann & Felger 1997). See *E. micromera* for comparison with *E. polycarpa.*

OP: Quitobaquito: 27 Nov 1939, *Harbison 26177*; Felger 90-95. Dripping Springs, 16 Apr 1952, *Parker 7934.* Alamo Canyon, 16 Feb 1979, *McLaughlin 1935.* 1 mi W of Hwy 85 on Puerto Blanco Drive, *Van Devender 31 Aug 1978.* E side of Sierra Santa Rosa, along border, 1635 ft, 12 Mar 2003, *Felger 03-357.*

CP: Pinacate Lava Fields, sandy soil, 20 Mar 1933, *Shreve 6214.* Pinta Sands, *Simmons 24 Nov 1962* (CAB). Agua Dulce Pass, *Simmons 19 Aug 1964* (CAB). O'Neill's Grave, 11 Apr 1992, *Harlan 185.* N side of Tule Mts, 2 Feb 1992, *Felger 92-59.* Heart Tank, 27 Feb 1993, *Felger 93-164.*

TA: Granitic hills, SW side of Tinajas Altas Mts, 10 Jan 2002, *Felger* (observation). Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-13.*

***Euphorbia prostrata** Aiton

[*Chamaesyce prostrata* (Aiton) Small] Figures 10, 23.

Small, warm-weather ephemerals (short-lived perennials elsewhere); often pubescent with short, crinkled, white hairs. Leaf blades 4.5–8.5 mm long, obovate-elliptic to oblong, usually with some hairs; margins serrated, usually minutely so and without magnification sometimes appearing entire. Stipules separate and slender, or united basally. Cyathia 0.4 mm wide; glands pink, transversely elliptic, 0.15 mm wide, without appendages or appendages minute and generally not as wide as the glands. Stamens 2–5 per cyathium. Capsules green, usually with white hairs especially on the angles (keels) and near the base. Seeds 0.7–0.8 mm long, ashy to tan, with a sharply-angled or ragged-edged crest and transverse ridges; not conspicuously mucilaginous when wet but adhering tenaciously after drying. (Description based largely on specimens from nearby northwestern Sonora.)

Usually near roadsides or other disturbed areas, mostly on sandy loam or gravelly wash beds; recorded in the northern part of Organ Pipe and likely more widespread in low areas.

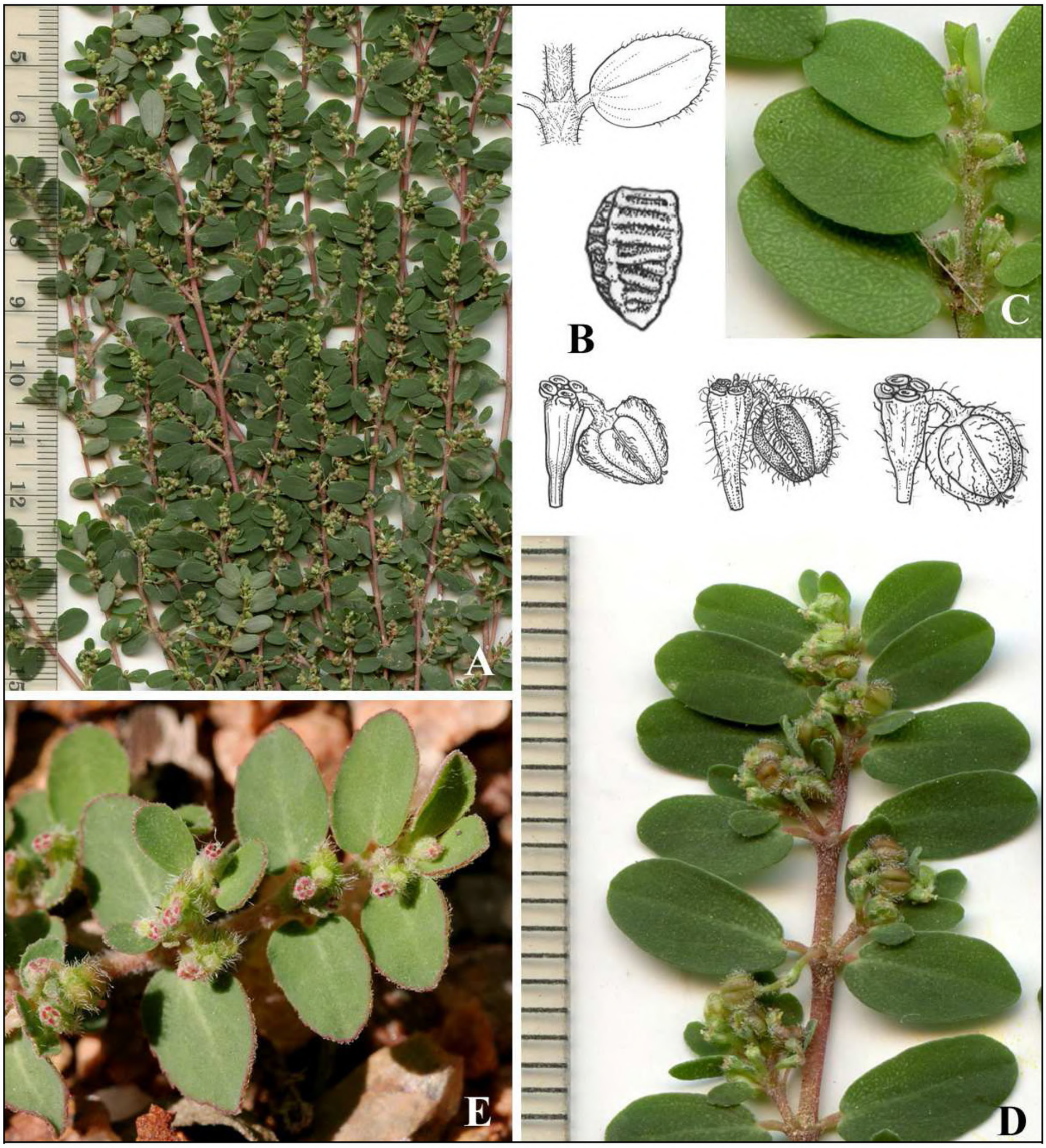

Figure 23. *Euphorbia prostrata*. (A & D) Tucson, 28 Sep 2014. (B) By Lucretia Breazeale Hamilton. (C) N end of Bates Mts near Bates Well Road, 4 Aug 2014. (E) New Mexico State University Campus, Las Cruces, 26 Sep 2006, photo by Patrick Alexander.

Native from southeastern United States to South America; weedy and naturalized in many warm regions of the world.

OP: Armenta Ranch, *Wirt 20 Jul 1990* (ORPI). Cuerda de Leña within 1 mi of N boundary of Organ Pipe, 7 Oct 2006, *Rutman 20061007-13* (2 sheets, ARIZ 412364 & 412374).

Euphorbia setiloba Engelmann ex Torrey
[*Chamaesyce setiloba* (Engelmann ex Torrey) Millspaugh ex Parish]
Fringed spurge; *golondrina*. Figures 11F, 24.

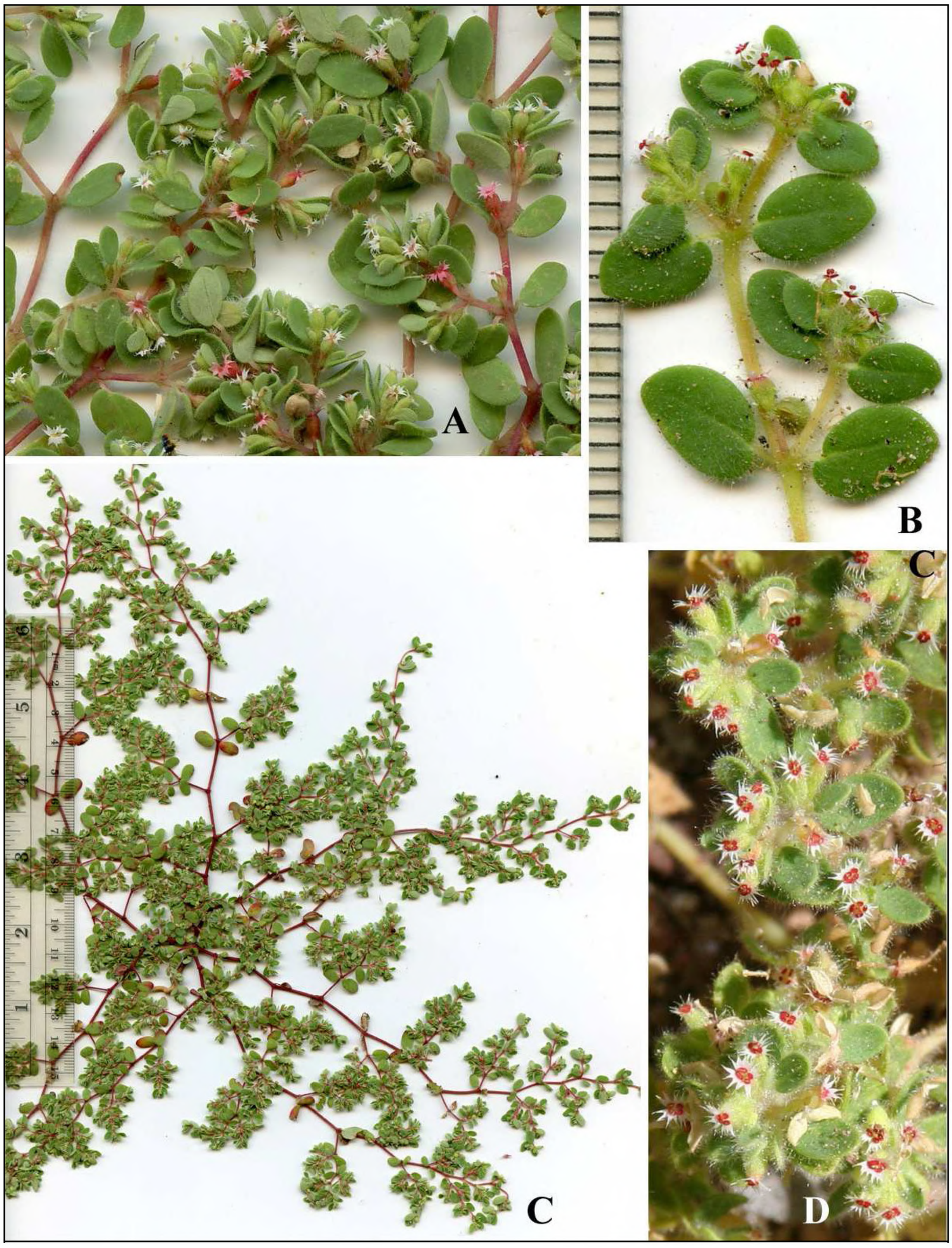

Figure 24. *Euphorbia setiloba*. (A & B) Knucklehead Wash, base of Childs Mtn, 5 Sep 2014. (C) Alamo Wash near Hwy 85 bridge, 17 Sep 2014. (D) Cuerda de Leña near N boundary of Organ Pipe, 30 Sep 2006.

Non-seasonal ephemerals; densely glandular-pubescent including capsules. Herbage reddish in drier or cooler seasons, green to yellow-green in hot, humid seasons. Stems slender and wire-like, often reddish, with age often blackish and usually prostrate. Leaf blades 1–6.5 mm long, broadly ovate to elliptic or oblong, the margins entire; stipules minute conical "spurs" to 0.2 mm long and often not apparent (see *E. arizonica*). Cyathia 0.8–1.0 × 0.5–0.8 mm, urn-shaped (see *E. arizonica*), usually reddish; glands 0.2–0.3 mm wide, the appendages white, becoming pink with age, deeply divided into slender, pointed segments (the laciniate appendages are unique among Sonoran Desert euphorbias), the cyathium looking like a tiny star-shaped flower. Seeds 0.8–0.9 mm long, with a few low furrows or sometimes smooth; not conspicuously mucilaginous when wet but adhering tenaciously upon drying.

Often in broad, sandy-gravelly washes, canyon bottoms, and bajadas; widely scattered and common across the flora area, probably mostly at low elevations. The plants are frost-sensitive, and sometimes recover from light frost with new growth in the same season, or the plants perish with more severe freezing.

Southwestern United States to Baja California Sur and Sinaloa.

OP: Growler Canyon, 19 Mar 1975, *Lehto L18317* (ASU). Aguajita Wash, 13 Sep 1986, *Felger 86-276*. 0.8 km E of summit of Twin Peaks, 1 Aug 1990, *Baker 7885* (ASU). E of Armenta Ranch, *Rutman 30 Sep 2006*.

CP: Wash at N side of Tule Mts, 2 Feb 1992, *Felger 92-58*. Little Tule Well, 12 Jun 1992, *Felger 92-535*.

TA: Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-14*.

Euphorbia trachysperma Engelmann
[*Chamaesyce trachysperma* (Engelmann) Millspaugh]
Rough-seed spurge. Figures 11G, 25.

Summer ephemerals, glabrous, mostly 30–50 (90+) cm tall, usually taller than wide, the stems often relatively stout, the branches mostly ascending and straight. (Drought-stressed stunted plants only 2.5–5 cm tall can be reproductive.) Longer internodes 3.5–6 cm. Leaf blades often 3–5 cm long, linear to ovate-lanceolate, the margins minutely toothed (serrulate) at least near the tip. Stipules separate, ca. 1 mm long. Cyathia 1.5 mm wide, the glands green, round, 0.3–0.4 mm wide, the appendages pinkish, minute and inconspicuous although larger than the glands. Seeds 2.1–2.6 mm long, chunky and strongly 4-angled (quadrangular in cross section), gray to brown, granulated with a white waxy surface when fresh; copiously mucilaginous when wet.

Seasonally abundant in Cabeza Prieta in wet mud in Las Playas and at a dirt-tank waterhole. Also locally common in adjacent northwestern Sonora during the hot, humid, summer rainy season in playas and low-lying flats subject to temporary flooding.

Southern and central Arizona to northwestern Sinaloa, and Baja California Sur.

CP: Jose Juan Tank, locally common among mesquites near edge of charco, 14 Sep 1992, *Felger 92-723* (CAB). Las Playas, 28 Nov 2001, *Felger 01-568*. San Cristobal Wash, crossing Camino del Diablo/Bates Well Road, xeroriparian, 26 Sep 2013, *Rutman 20130926-6*.

Sonora: Mpio Benjamin Hill, 5 km S of Benjamin Hill on Mex 15, disturbed Sonoran desertscrub, uncommon, 27 Dec 2000, *Reina G. 2000-897* (plants 2.5–5 cm tall, with seeds).

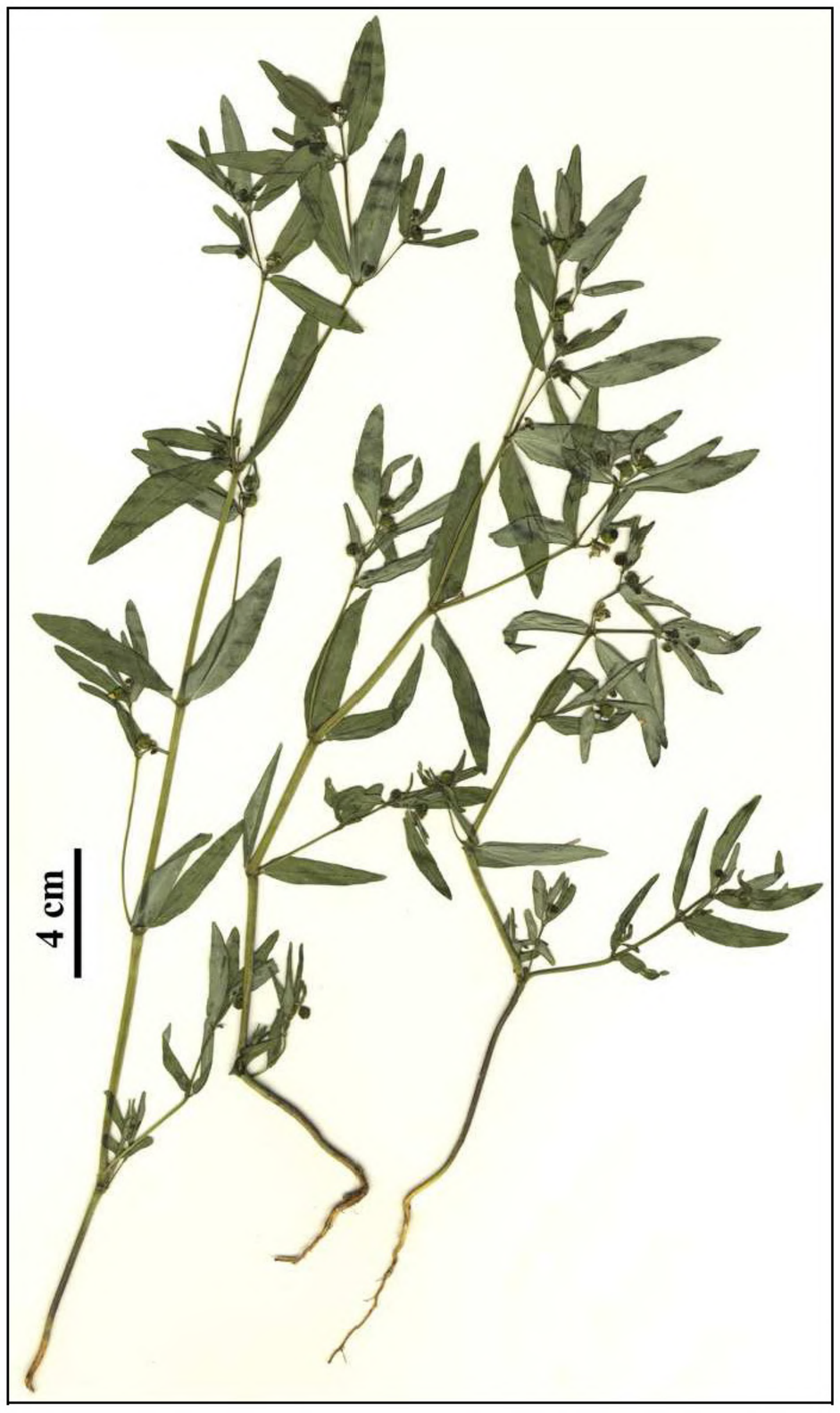

Figure 25. *Euphorbia trachysperma.* Jose Juan Charco, 14 Sep 1992, *Felger 92-723* (ASU).

†Euphorbia spp.

OP: †Alamo Canyon, leaves, capsules, 1150 to 29,110 ybp (5 samples). Montezuma's Head, leaves, capsules, 13,500 to 21,840 ybp (3 samples). †Puerto Blanco Mts, capsules, seeds, modern to 9070 ybp (10 samples).

TA: †Tinajas Altas, capsules, 5940 to 11,040 ybp (4 samples).

Euphorbia section **Poinsettia**

Annuals to perennial herbs (in the flora area; also shrubs or small trees elsewhere). Cauline leaves alternate or sometimes opposite; without conspicuous stipules; sub-cyathial leaves (bracts) pseudo-whorled and often infused with white to red pigments. Glands cup-like or bilabiate, usually l–3 per cyathium; appendages none. Seeds with or without a caruncle.

New World; about 20 species; the center of diversity is in Mexico where about 13 species occur. The two species in the flora area have C_3 photosynthesis (Webster et al. 1975).

1. Leaves opposite; seeds 2–3 mm long; petaloid appendages usually conspicuous, white or pink, and usually toothed ..... Subsection **Exstipulatae**: **Euphorbia exstipulata**
1. Leaves opposite below, alternate above; seeds 3–4 mm long; petaloid appendages not white or pink, not toothed, or absent.

2. Leaves linear, less than 3 mm wide; cyathia with 2 or more inconspicuous glands; capsules pubescent; seeds 3.5–4 mm long including a conspicuous caruncle. ..... Subsection **Erianthae**: **Euphorbia eriantha**

2. Leaves lanceolate to obovate, at least 10 mm wide; cyathia with a single, conspicuous cup-shaped gland; capsules glabrous; seeds 3–3.5 mm long, with an inconspicuous caruncle (or caruncle absent)..... Subsection **Stormieae**: **Euphorbia heterophylla**

Euphorbia section **Poinsettia** subsection **Eriantha**

This subsection has a single species.

Euphorbia eriantha Bentham

Beetle spurge. Figure 26.

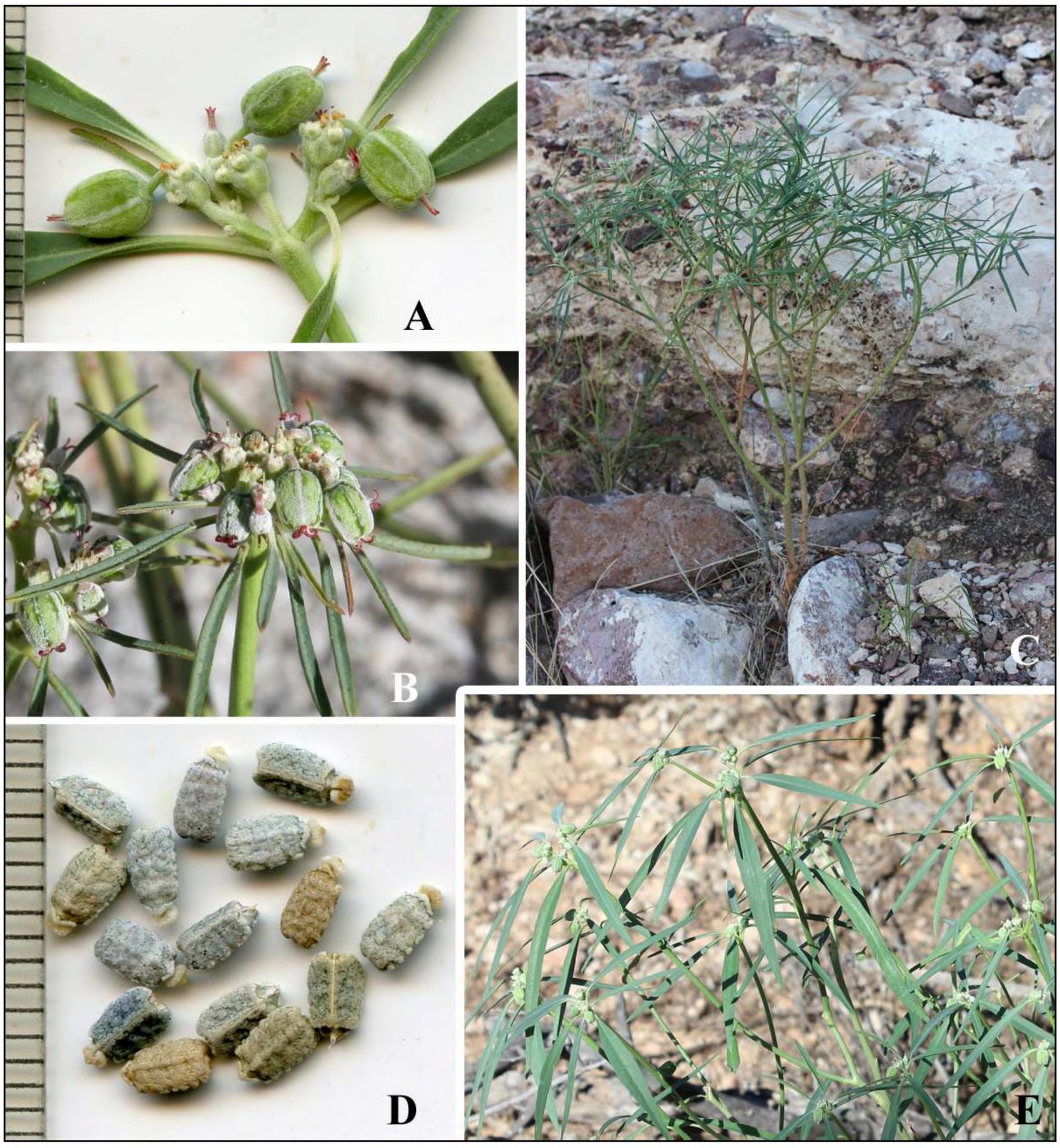

Figure 26. *Euphorbia eriantha*. (A) Daniels Arroyo, 24 Aug 2014. (B) Canyon at N end of Little Ajo Mts, 27 Mar 2005. (C) Wash crossing the northern Ajo Mountain Drive, Diablo Mts, 26 Aug 2014. Foothills E of Pinkley Peak, Puerto Blanco Mts: (D) 30 Sep 2014; (E) 12 Aug 2013.

Non-seasonal ephemerals/annuals, and sometimes surviving the winter as a "long-lived annual," although mostly seen as spring ephemerals. Plants often (15) 25–70 cm tall, the main axis usually erect with few to many branches above. Leaves linear, 2–6 cm long, less than 3 mm wide, the lower ones opposite, alternate above and usually quickly deciduous, the uppermost ones (bracts) in a whorl beneath the cyathia; stipules glandular and minute. Young herbage and inflorescences, including cyathia, ovaries, and capsules, densely pubescent with short, white, appressed hairs. Cyathia clustered at branch tips, noticeably longer than wide, involucres minute, with (2 or 3) 4 or 5 inconspicuous glands, these obscured by hairs and herbaceous, flap-like, feathery appendages arching upwards and inwards over the glands. Anthers and styles red, the styles not branched and protruding before the female pedicel elongates and before the male flowers (stamens) appear. Seeds 4-angled, mottled with white, gray, brown, or blackish markings, coarsely tuberculate, and with a minute cellular pattern, 3.5–4 mm long including a conspicuous whitish caruncle nearly as wide as the seed; mucilaginous when wet.

Widespread in the flora area; sandy soils including washes, bajadas, dunes, and sometimes on rocky slopes.

Baja California Sur to southeastern California and eastward to southwestern Texas, Coahuila, Durango, and lowlands of Sonora to northwestern Sinaloa.

OP: Bates Well, 5 Mar 1940, *Benson 9928*. Alamo Canyon, *McDougall 15 Mar 1941*. Dripping Well, Puerto Blanco Mts, 18 Mar 1945, *Gould 3018*. Aguajita Wash, 14 Sep 1988, *Felger 88-430*.
CP: 5 mi N of Tule Tank on road to Christmas Pass, 2 Feb 1992, *Felger 92-75*. Pinta Sands, 11 Apr 1993, *Felger 93-424*.
TA: Vicinity of Coyote Wash along Camino del Diablo, 20 Mar 1992, *Yeatts 3242* (CAB). Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-12*.

Euphorbia section **Poinsettia** subsection **Exstipulatae**

This subsection includes two species in southwestern North America to southern Mexico (Yang et al. 2012).

Euphorbia exstipulata Engelmann
[*Chamaesyce exstipulata* (Engelmann) Rydberg. *Euphorbia exstipulata* var. *lata* Warnock & M.C. Johnston] Figure 27.

Small annuals from a slender taproot, with opposite branching. Leaves opposite, 2–4 cm long, linear to lanceolate-elliptic (or ovate elsewhere); margins serrate. Cyathia in terminal clusters; involucral glands 4 or 5, oblong to circular, stalked (stipitate), laterally compressed and concave; involucral appendages white or pink, and toothed (also entire elsewhere). Ovaries and capsules glabrous or pubescent on and near the keels. Seeds broadly ovoid, quadrangular to rounded in cross-section, coarsely tuberculate with 2 transverse ridges and a minute caruncle.

Known in the flora area from at least one site at high elevation in the Ajo Mountains where it was locally common. The nearest known record is from the Sand Tank Mountains in the Sonoran Desert National Monument, and it also occurs near the summit of Table Top Mountain in the same national monument, and in the Baboquivari Mountains.

Widespread in Arizona above the desert and similarly in northeastern Sonora. Southwestern North America to southern Mexico. It was not included in the Euphorbiaceae of Sonora (Steinmann & Felger 1997) as the specimens have been collected since then.

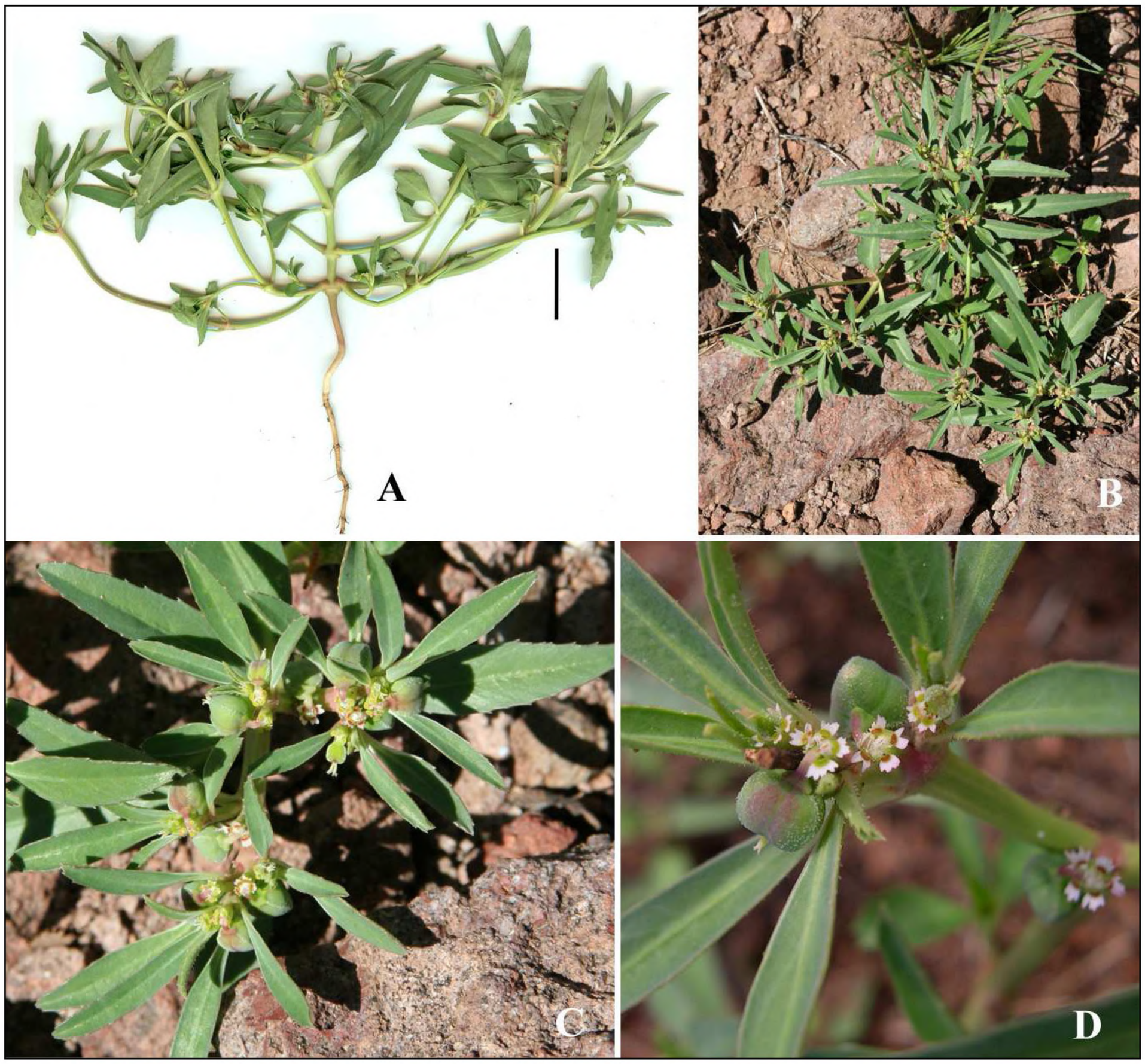

Figure 27. *Euphorbia exstipulata*. (A–C) Saddle between Arch and Boulder canyons, 16 Oct 2003. (D) Sedona, Yavapai Co., 19 Aug 2004, photo by Max Licher (SEINet).

OP: Ajo Mts, dry saddle between Arch and Boulder canyons, 32°02.12'N, 112°42.4'W, 3600 ft, erect annual, 16 Oct 2003, *Rutman 20031016-18*.

Maricopa Co.: Sand Tank Mts, Sonoran Desert National Monument, N end of Arrowhead Mtn, steep N-facing slope, 3500 ft, erect annual with succulent leaves, with *Larrea*, *Canotia*, *Aloysia*, and *Viguiera*, 29 Nov 2003, *Rutman 20031129-12*.

Pinal Co.: Table Top Mtn., basin on summit of peak, 4100 ft, basalt substrate, 3 Sep 1981, *Butterwick 7895* (ASU).

Sonora: Mpio de Cananea, 23 km NE of Cananea on Mex Hwy 2, 1550 m, grassland, common annual on rocky road cut, 9 Sep 2002, *Reina G. 2002-587* (det. V.W. Steinmann, ARIZ, ASU, USON).

Euphorbia section **Poinsettia** subsection **Stormieae**

This clade includes 21 species of annuals to small trees, widespread in the New World and centered in Mexico. The Christmas poinsettia, *E. pulcherrima* Willdenow, native to Mexico, is included here.

Euphorbia heterophylla Linnaeus
[*Poinsettia heterophylla* (Linnaeus) Klotzsch & Garcke]
Mexican fire-plant, Mexican poinsettia, wild poinsettia. Figure 28.

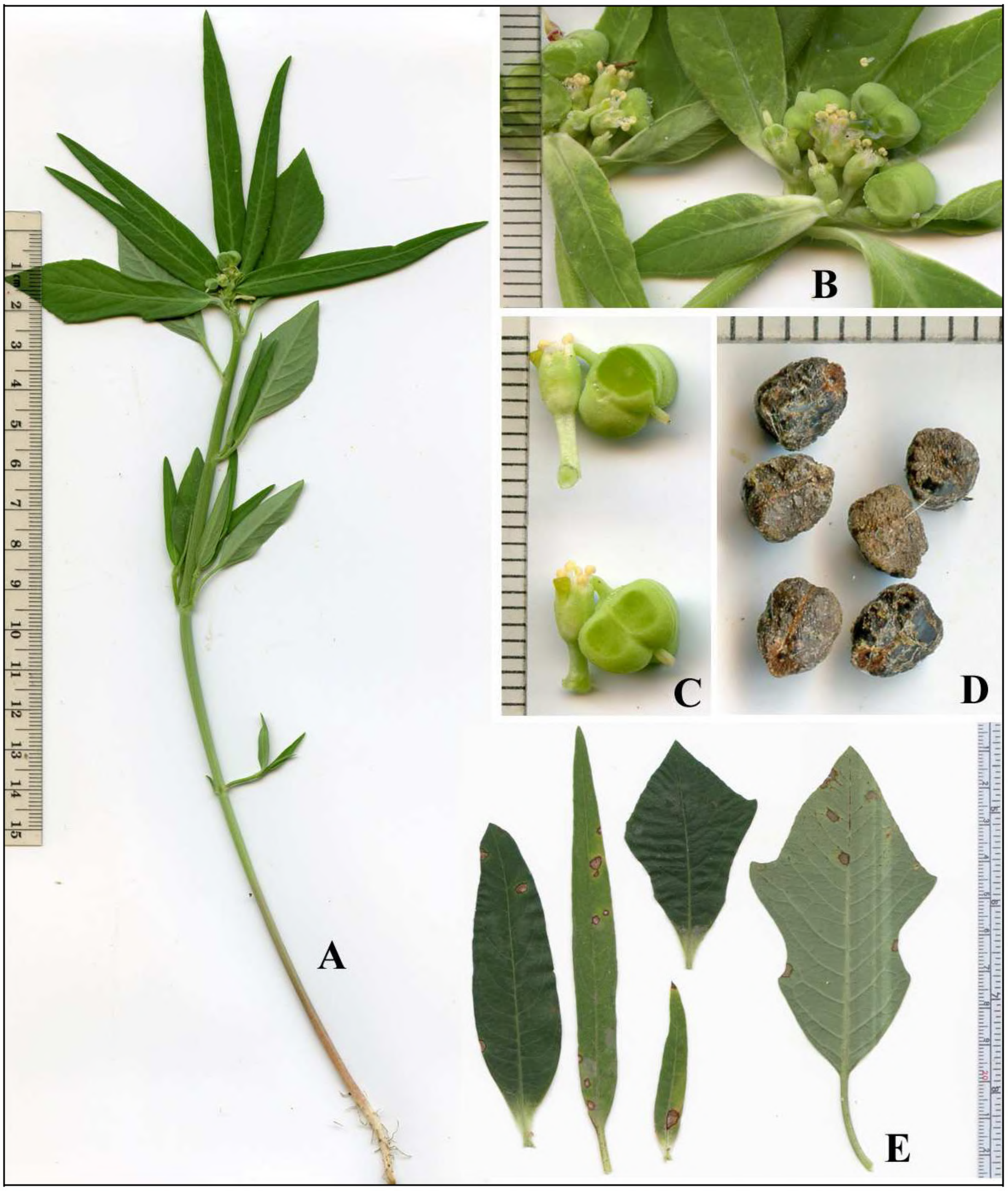

Figure 28. *Euphorbia heterophylla.* Roadside ditch, Hwy 86 between Why and Pisinimo, Pima Co.: (A) 8 Aug 2014; (B & C) 23 Aug 2014; (D) 11 Sep 2014; (E) 12 Sep 2008. Capsules partially flattened by scanner.

Warm-weather annuals; often robust with a single main axis and sparsely branched or not branched. Leaves opposite below, alternate above, and the uppermost ones (bracts) whorled below

the flower heads. Leaves highly variable, sometimes even on the same plant, 6–18 cm long, 0.8–5.5 cm wide, petioles short to long, the blades linear, lanceolate, elliptic, obovate, or obovate, the margins entire or coarsely lobed or toothed. Leaves below the cyathia may be white, pink, or reddish like a miniature poinsettia, although this coloration not seen on the few specimens from Organ Pipe and nearby areas. Cyathia with 1 gland, this cup-like with a circular opening and without a petaloid appendage. Ovary and capsules glabrous. Seeds 3–3.5 mm long, mottled, and with a flat caruncle (or caruncle may be absent); seeds not mucilaginous (e.g., *Helmkamp 7970*, Cochise Co., 2 Oct. 2002, UCR; Andrew Sanders, pers. comm. to Felger, 10 Feb 2015).

Canyons in the Ajo Mountains and occasional in washes near the northern boundary of Organ Pipe.

Also known from the Kofa Mountains and eastward in southern Arizona to Texas and Florida, and to South America. This attractive plant, often grown as an ornamental, has become naturalized and a serious agricultural weed in many warm regions worldwide. Although potentially toxic like other spurges, it is widely used medicinally, especially in parts of Africa.

OP: Bull Pasture, *Wirt 13 Aug 1990*. Kuakatch Wash, between Armenta Ranch and Cuerda de Leña, *Rutman 5 Oct 1995* (ORPI). Saddle between Arch and Boulder Canyons, ca. 3600 ft, 26 Oct 2003, *Rutman 20031026-40*.

Euphorbia subgenus **Esula**

Esula is a worldwide clade of about 480 species of diverse growth forms, although most diverse in north-temperate regions, especially in the Old World (Riina et al. 2013). Temperate region species, termed "leafy spurges" by Ricarda Riina, have C_3 photosynthesis. This subgenus is essentially absent from the Sonoran Desert except for the single population of *E. spathulata*, and *E. peplus* Linnaeus, a common, cool-season garden and farm weed in the Sonoran Desert region, native to the Mediterranean Region and now worldwide. These two species have relatively thin leaves and do not look like "desert plants." *E. spathulata* is in section *Helioscopia*, while *E. peplus* is in section *Tithymalus* (Riina et al. 2013).

Euphorbia spathulata Lamarck

Warty spurge. Figure 29.

Cool-season annuals, 10–35 cm tall; glabrous and bright green, stems mostly erect, solitary or branching from the base. Leaves 15–21 mm long, sessile, the blades obovate to broadly oblong, rounded or blunt at the tip, the margins serrated; alternate on stems except opposite or whorled below flowering branches and cyathia; stipules none. Cyathia including glands and flowers green to yellow-green; glands 4, without appendages. Ovary and capsule conspicuously tuberculate with warty glands. Seeds sub-globose, 1.5–2 mm wide, with a reticulate surface and a minute white caruncle; not mucilaginous when wet.

Common in wet mud of Las Playas following times of favorable rains, often among dwarfed mesquites. *Euphorbia spathulata* is not known elsewhere within the Sonoran Desert except a few records at the northeastern edge of the desert (see SEINet 2015). This leafy spurge is widely distributed in non-desert areas of Arizona as well as much of the United States and northern Mexico, and it also occurs in South America.

At Las Playas *E. spathulata* grows with other "playa plants" generally seen locally only after temporary flooding conditions: *Amaranthus crassipes, Chamaesaracha coronopus, Cyperus esculentus, C. squarrosus, Eragrostis pectinacea, Erigeron divergens, Eryngium nasturtiifolium, Euphorbia trachysperma, Hoffmannseggia glauca, Malvella sagittifolia, Marsilea vestita, Physalis*

lobata, Planodes virginicum, Sibara angelorum, Teucrium cubense, and *Veronica peregrina. Planodes virginicum* and *Sibara angelorum* (Brassicaceae) are disjunct from their general distribution, and *Planodes virginicum* is not known elsewhere within the Sonoran Desert (Felger et al. 2015). These plants form green carpets following the uncommon occasions when the otherwise barren playas become temporarily flooded. How did *E. spathulata* get there? Birds are unlikely vectors since the seeds are not mucilaginous. Human agency seems more likely, as this place was a crossroads for travelers and their horses, cattle drives, and early auto travel. "Pumpelly (1918) recounts being saved from thirst here by a summer thunderstorm, and Bryan (1925: 419) reminds us that 'all the ancient routes from Sonoita to Yuma came through las Playas because there was a good possibility of finding water there and because of the presence of horse feed'" (Broyles et al. 2007: 646).

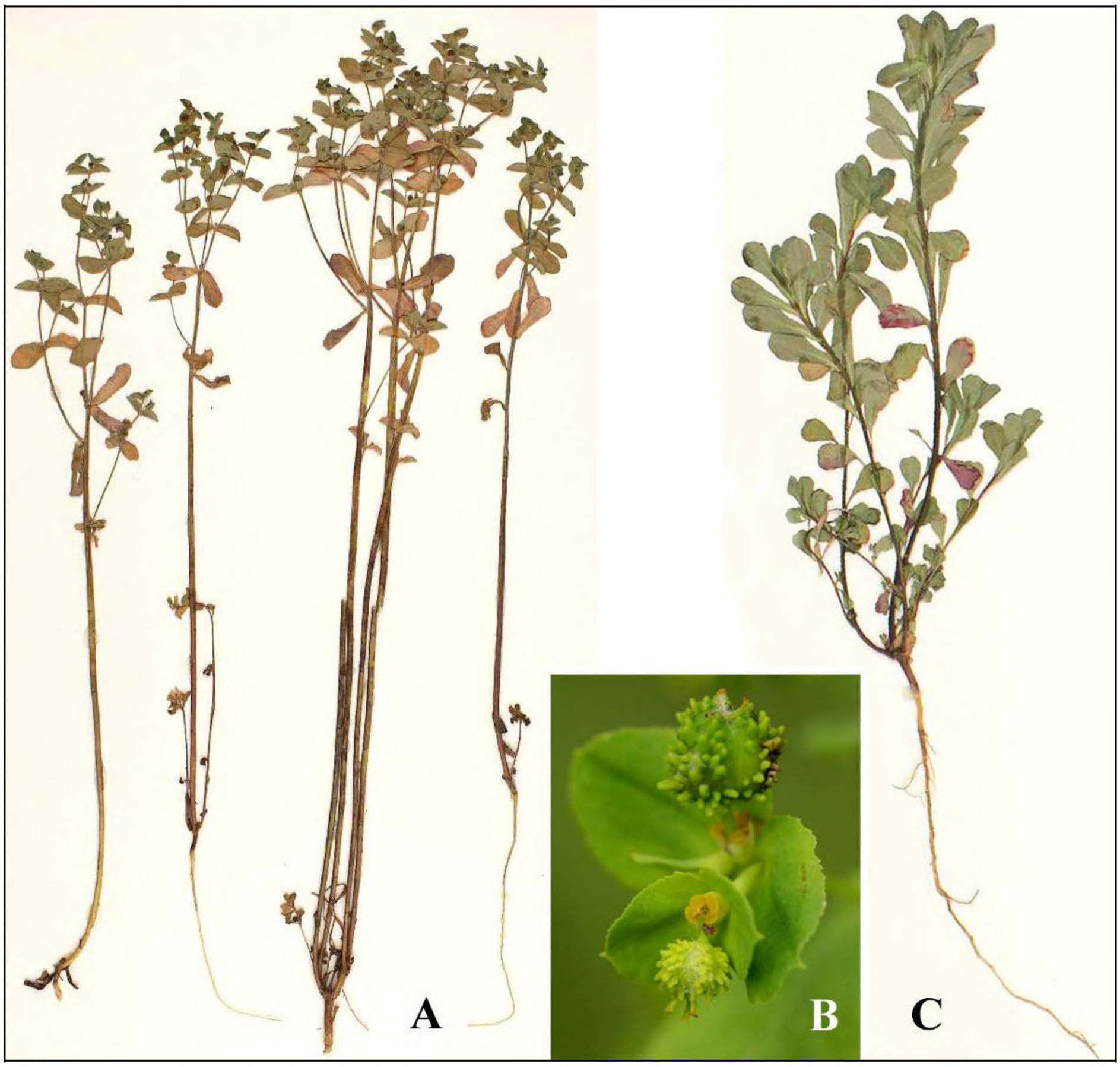

Figure 29. *Euphorbia spathulata.* Las Playas: (A) *Phelps 19 Mar 1978* (ASU); (C) 11 Jan 2002, *Felger 02-33.* (B) Sedona, Coconino Co., 11 Apr 2001, photo by Max Licher (SEINet).

CP: Las Playas: Common, *Phelps 19 Mar 1978* (ASU). S edge of Las Playas, 0.25 mi NE of Border Monument #180, "channels" still damp from previous standing water, with mesquite, 10 Apr 1978, *Lehto L-*

22467 (ASU). Clay surface of playa, juvenile, fairly numerous here, [with] *Marsilea*, 28 Nov 1997, *Harlan 478*. Channel banks, locally abundant, 1 Mar 1998, *Harlan 493* (ASU). Small plants, no flowers seen, some with reddish stems, common and widespread, 28 Nov 2001, *Felger 01-569*. Clayish soil with mesquite shrubs, 11 Jan 2002, *Felger 02-33* (ARIZ, ASU).

Jatropha

Multiple-stemmed shrubs with flexible stems in the flora area (herbaceous perennials to trees elsewhere). Leaves alternate or fascicled on short shoots, and drought-deciduous. Flowering with summer-fall rains, the fruits ripening in the same season. Stems and larger roots ooze blood-like sap when cut, hence the name *sangrengado* (dragon's blood). Male and female flowers on the same plant (those in the flora area). Fruit a capsule, those in the flora area 1- or 2-seeded by abortion of 1 or 2 carpels or ovules, or sometimes 3-lobed. Seeds with a caruncle.

Mostly tropical and subtropical, many in semi-arid regions and some in deserts, worldwide, mostly tropical Americas and many in Africa; 175 species.

1. Short-shoot leaves sessile or subsessile, the long-shoot leaves with petioles less than half as long as blades; leaves about twice as long as wide..... **Jatropha cuneata**
1. Petioles about as long as the blades; leaf blades about as broad as or broader than long.

    2. Stems generally reddish; leaf blades shiny, and acute or pointed at tip... **Jatropha cardiophylla**
    2. Stems generally grayish white or ashy; leaf blades dull, and blunt or rounded at tip ..... **Jatropha cinerea**

†**Jatropha cardiophylla** (Torrey) Müller Argoviensis
Heart-leaf limberbush; *sangrengado*. Figure 30.

Many-stemmed shrubs to ca. 1 m tall, often spreading clonally from thickened roots, with blood-red sap and reddish bark; glabrous. Foliage produced only during the brief summer rainy season, on long shoots and short, spur branches. Leaves mostly more than 2–3 cm long, prominently petioled, the blades broadly triangular, heart-shaped to ovate or rounded, rather thick, bright green and shiny; margins nearly entire to shallowly toothed, the teeth and margins with sessile glands. Inflorescences moderately branched, mostly several-flowered, as long as or longer than the leaves. Flowers white to pinkish, usually in July and August. Capsules mostly 1-seeded.

Widespread in Organ Pipe including the Ajo Mountains, but not in the southwestern part of the Monument (west of Quitobaquito). It has been in the mountains of Organ Pipe for at least 3500 years.

Southern Arizona to southwestern Sonora.

The flexible stems were sometimes used for basketry by the Tohono O'odham (Castetter & Underhill 1935). "The clear sap coagulates quickly and on contact with air and can be used for stanching the flow of blood from slight wounds" (Kearney & Peebles 1960: 509).

OP: Senita Basin, 1700 ft, 25 Jul 1978, *Bowers 1393*. Visitor Center, *Van Devender* 30 Aug 1978. Lost Cabin Mine Site, 2 Aug 1990, *Baker 7888* (ASU). Sierra Santa Rosa, 12 Mar 2003, *Felger* (observation). The Cones, trail above Bull Pasture, 3730 ft, 10 Apr 2005, *Felger* (observation). †Puerto Blanco Mts, on ridge, seeds, 3480 ybp.

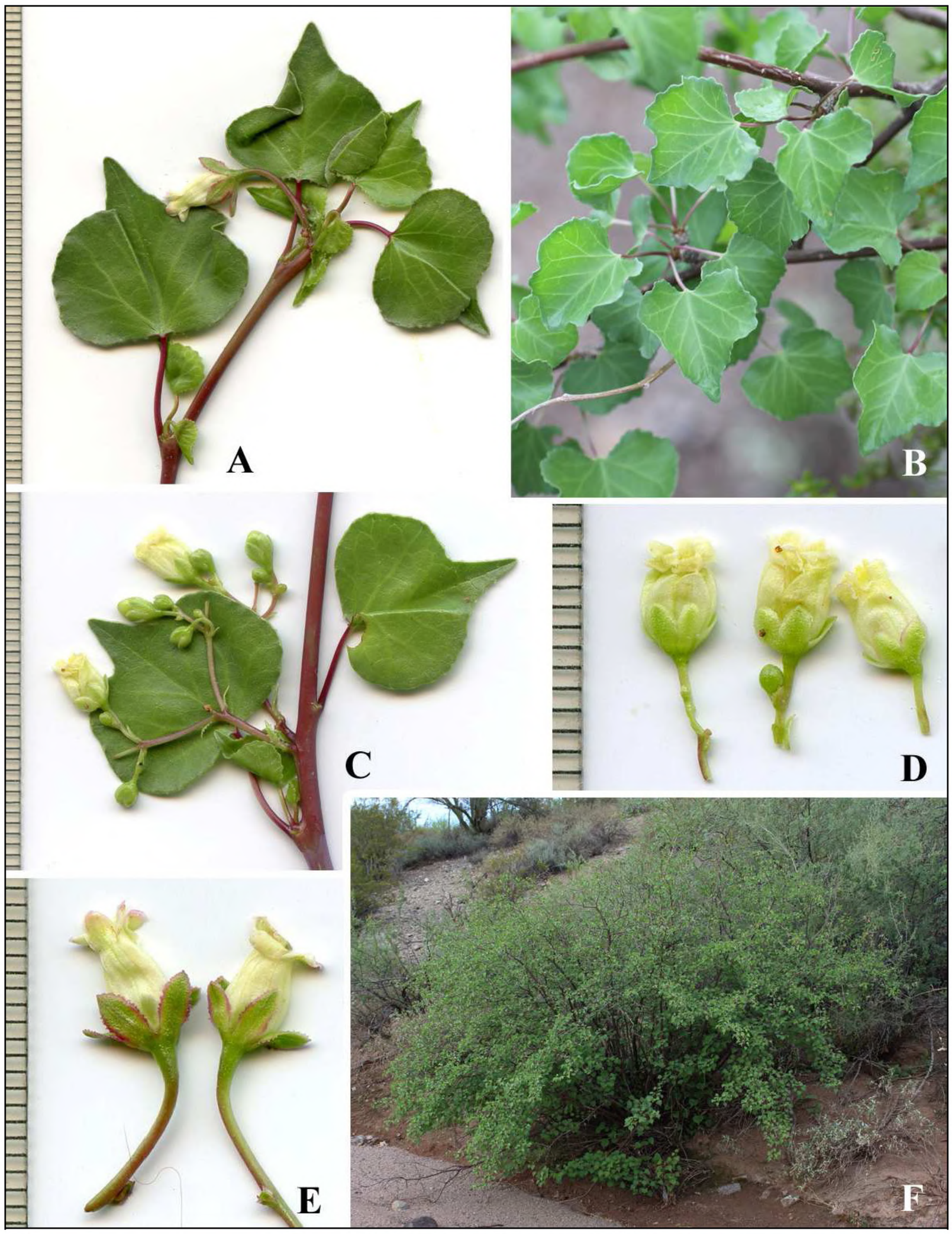

Figure 30. *Jatropha cardiophylla.* (A, C–F) Ajo Scenic Loop, Little Ajo Mts, 30 Jul 2014: (D) male flowers, (E) female flowers. (B) Sikort Chuapo Mts on Pipeline Road, NE of Ajo, 7 Sep 2012.

Jatropha cinerea (Ortega) Müller Argoviensis
Ashy limberbush; *sangrengado*; komagĭ va:s. Figure 31.

Multiple-stemmed shrubs often 1–2 m tall; stems rather thick and semi-succulent. Young herbage, inflorescence branches, calyces, and corolla buds moderately to densely pubescent with short white-woolly hairs. Leaves produced following rains during warm times of the year and quickly drought-deciduous. Long shoots produced with summer-fall rains and with leaves larger than short-shoot leaves. Long-shoot leaves on widely spaced nodes, the blades often shallowly 3-lobed, the lobes often with a few shallow teeth. Stipules apparently lacking (not found on specimens from

Arizona and Sonora, although some authors state stipules are present; Felger 2000). Short-shoot leaves with petioles 2.5–8 cm long, the blades 3–9 × 4–11.5 cm, more or less kidney-shaped, the upper surface greener and with sparser pubescence than the often densely pubescent, gray-green lower surface, the margins with few, small glands. Male flowers in compact, many-flowered clusters on slender inflorescence branches, the corollas pinkish-white or rose-colored, becoming white with age. Female flowers solitary, the sepals 4–6 mm long, linear to oblong, densely pubescent outside, glandular inside, the corollas dark pink inside. Fruits often 2-lobed and 2-seeded (1 carpel aborts), or sometimes 3-lobed; seeds round, 1 cm wide. Flowering in summer–early fall following rains, the fruits ripening in the same season, or sometimes flowering in spring.

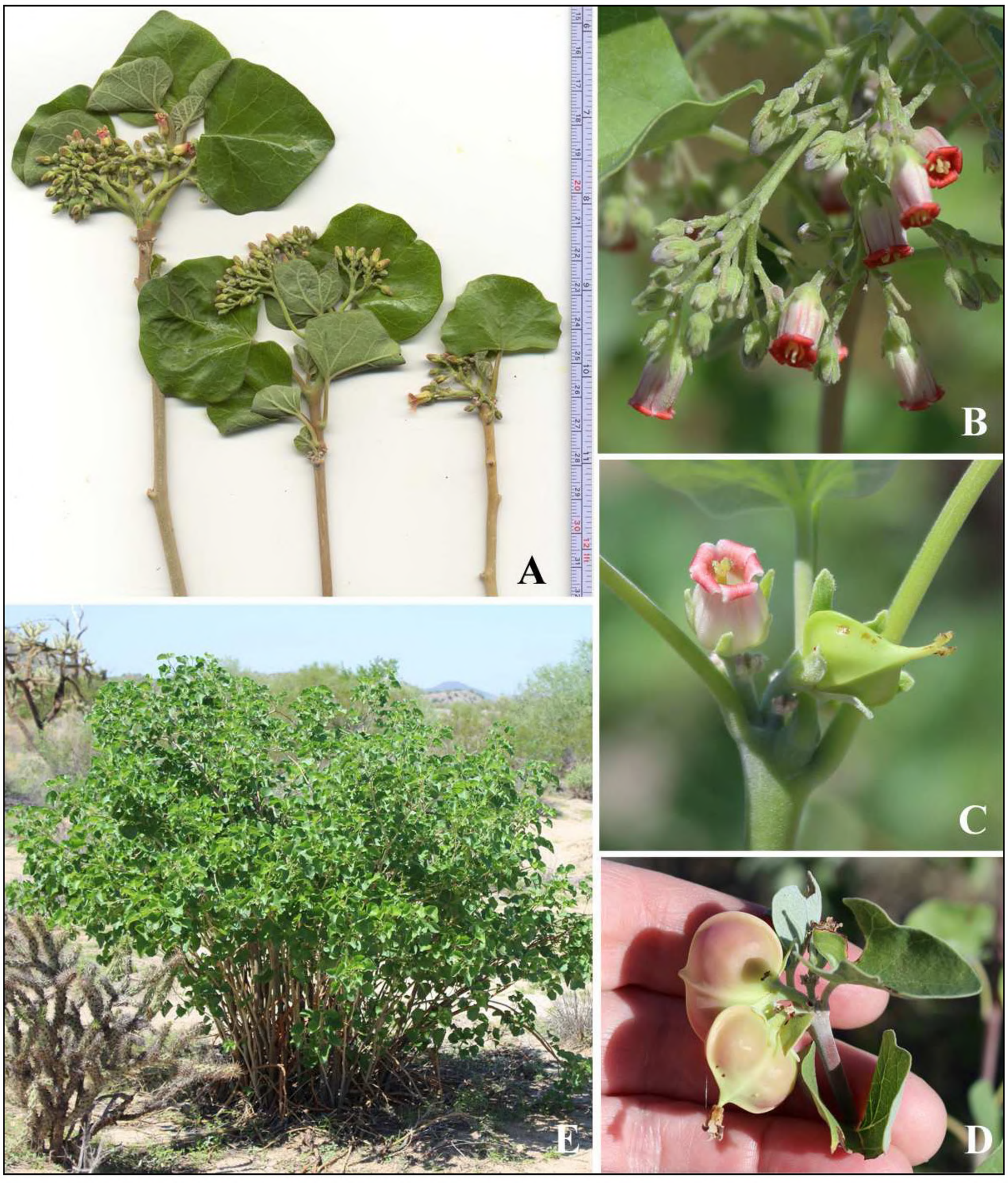

Figure 31. *Jatropha cinerea*. International boundary 3 mi W of Quitobaquito: (A) 26 Aug 2013; (B–E) 5 Sep 2013: (B) male flowers, (C) female flower and developing fruit, (D) young fruits.

Locally near the international border in the southwestern part of Organ Pipe, mostly along margins of small washes and on rocky hillsides. Not known elsewhere in the United States. The northern limit is undoubtedly determined by freezing weather (Turner et al. 1995); plants in the flora area are often freeze-damaged, sometimes freeze-killed to the ground and subsequently resprout (e.g., *Felger 88-465*). Widespread in northwestern Mexico.

Hia-Ced O'odham used the plant as a remedy for toothache and sores (Felger et al. 1992).

OP: Quitobaquito, *Nichol 28 Apr 1939*. Rancho Bonito, La Abra Valley, 5 Dec 1939, *Harbison 26207* (SD). 2 mi W of Quitobaquito, 1000 ft, sandy silty soil in valley, common, 29 Jul 1950, *Supernaugh 435*. Senita Basin, shrub to 3 ft tall, 25 Jul 1978, *Bowers 1392*. 0.9 mi W of Quitobaquito (old fields below pond) on border road, sandy flat, locally common, shrubs 95+ cm tall, all show signs of die-back to ground due to freezing, mostly along wash margins, often growing among shrubs, 14 Sep 1988, *Felger 88-465*. Road to Quitobaquito Springs, shrub 1.5 m tall, 2 m broad, along wash, 11 Oct 1988, *Baker 7637* (ASU, DES). S of Senita Basin, Lost Mine Road, shrub to 2 m tall, locally abundant, mostly along drainage, 12 Oct 1988, *Baker 7642-A* (ASU, DES). Lost Cabin Mine Site, granitic sand of wash, ca. 1.5 m tall, [&] as broad, fruit still green, 2–3-lobed, 2 Aug 1990, *Baker 7887* (ASU). 2.5 mi W of Hwy 85 on S Puerto Blanco Drive, 1500 ft, N-facing hillside, 11 Aug 1990, *Felger 90-405*. Hocker Well, 3 Dec 1990, *Felger* (observation).

†**Jatropha cuneata** Wiggins & Rollins
Desert limberbush; *sangrengado*; va:s. Figure 32.

Multiple-stemmed shrubs, often 1–2 m tall. Roots thick, somewhat tuberous. Stems thick and semi-succulent, beset with knobby short-shoots, often freeze-damaged during severe winters. Glabrous or glabrate, or young herbage with short white hairs. Short-shoot leaves appearing after rains at almost any time of year except during the coldest periods, and quickly drought-deciduous, 4–21 (41) × 2.3–9 (11) mm, sessile or short petioled, spatulate-cuneate, the margins entire except the apex often shallowly notched. Seedlings and long shoots growing with hot-weather rains; long-shoot leaves often 20–55 × 14–25 mm, usually 3 (5)-lobed or cleft, petioled, and quickly drought-deciduous. Stipules absent (or difficult to find?) or of minute, reddish, spur-shaped glands. Male flowers several in subsessile or short inflorescences, the corollas white. Female flowers solitary or in pairs, corollas white or pink, the fruiting sepals 3–6 mm long. Fruits round, 1-seeded, the seed round, 9–10 mm wide with a minute, white-waxy caruncle. Flowering mostly with summer rains.

Rocky hills and mountains, and sometimes on upper bajadas; widespread across the flora area. Frost-sensitive and not at higher elevations in the Ajo Mountains. The only prehistoric record is from 1250 years ago at Tinajas Altas.

Southwestern Arizona to northwestern Sinaloa, most of the Baja California Peninsula, and islands in the Gulf of California.

The flexible stems were widely used for basketry (e.g., Felger & Moser 1985; Lumholtz 1912: 331; Betty Melvin in Zepeda 1985: 61) and a reddish dye was made from the roots (Felger et al. 1992). The tender split stems were used in baskets for coiling around cattail stalks (*Typha*) or beargrass leaves (*Nolina microcarpa*) (Philip Salcido & Delores Lewis in Felger et al. 1992). Childs (1954: 36) reports red dye for women's buckskin dresses made from a "bush which we call Leather Weed—the Mexicans call it Sangre en Grande."

OP: W of Bates Well, Growler Valley, *Shreve 28 Mar 1932*. Quitobaquito, *Nichol 3 Mar 1939*. Dripping Springs, 16 Apr 1952, *Parker 7965*. Senita Basin, 25 Jul 1978, *Bowers 1394*. Sierra Santa Rosa, 12 Mar 2003, *Felger* (observation).

CP: 7 mi E of Papago Well, 22 Mar 1935, *Peebles 10862*. Sierra Pinta, *Arnold 14 Nov 1937*. Agua Dulce Mts, 18 Mar 1945, *Gould 3004*. Heart Tank, *Monson 27 Mar 1955* (CAB). Charlie Bell Well, *Johnson*

26 Mar 1960. Cabeza Prieta Peak, N-facing side of summit, 14 Mar 1995, *Yeatts 3652* (CAB).

TA: Tinajas Altas: "Juice clear, flowing freely. Much branched shrub attaining 6–7 ft. Dryer stained with a reddish mucilaginous sap from cut end of branch," 29 Mar 1930, *Harrison & Kearney 6567*; 12 Feb 1977, *Reeves R-5358* (ASU). Borrego Canyon, 3 Feb 1990, *Felger* (observation). †Tinajas Altas, 550 m, leaves, seeds, 1230 ybp.

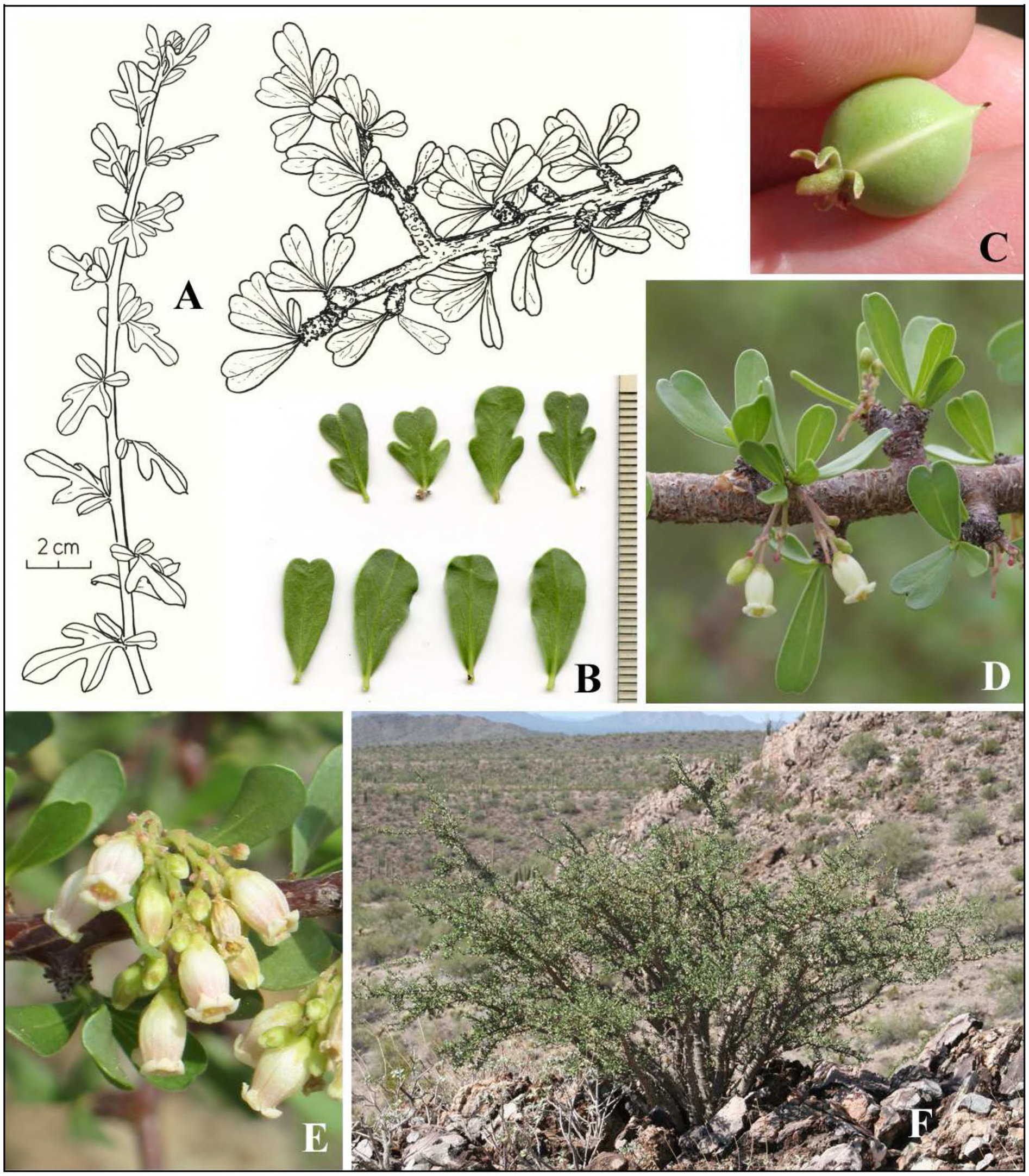

Figure 32. *Jatropha cuneata*. (A) Leaves on new shoot (left) and mature branch with spur branches (right), by Matthew B. Johnson. Ajo Scenic Loop Drive, Little Ajo Mts: (B) 28 Jul 2014; (D) female flowers, 1 Aug 2008. Little Ajo Mts near Ajo History Museum: 12 Sep 2008 (C) fruit, (E) cluster of male flowers; (F) 5 Sep 2011

Pleradenophora

Five species of trees and shrubs ranging from Arizona to South America (Melo et al. 2013). "Species of *Pleradenophora* were historically mostly classified within *Sebastiania.* Molecular phylogenetic analyses show *Sebastiania* in the broad sense is polyphyletic" (Wurdack in press).

†Pleradenophora bilocularis (S. Watson) Esser & A.L. Melo
[*Sebastiania bilocularis* S. Watson. *Sapium biloculare* (S. Watson) Pax]
Arizona jumping bean; *hierba de la flecha*; 'ina hita. Figure 33.

Multiple-stem shrubs 1.5–3 (4) × (1.5) 2–3 (4) m, with copious and toxic milky sap. Leaves alternate, glabrous and shiny green or often reddish with drought and cold weather, nearly evergreen to ultimately drought-deciduous, (2) 3–6 (11) × 0.5–2 (2.5+) cm, subsessile to short petioled, mostly lanceolate to elliptic, sometimes narrowly so; leaf margins with minute gland-tipped teeth and sometimes also with a few much larger, scattered, reddish-brown glands; also often with a pair of (or 1) rounded, yellowish to reddish glands 0.2–0.5 (0.9) mm wide at or near the base of the blade. Stipules to ca. 1.5 mm long, scale-like, reddish brown, and fringed. Inflorescences spike-like, 2–4.5 cm long, with 1 or 2 female flowers at the base (or female flowers sometimes not present), and male flowers above. Individual flowers small, sepals present, petals none. Female flowers with 2 prominent dark-purplish stigmas. Male flowers in clusters subtended by a short, succulent scale; each flower with 2 or 3 stamens and 2 short, thick glands; individual male flowers difficult to discern without careful dissection using magnification. Fruits of 2- (3)-seeded capsules. Seeds more or less rounded, ca. 6.5 mm wide, without a caruncle.

Washes, upper bajadas, canyons, hills, and mountains; widespread in Organ Pipe and the eastern part of Cabeza Prieta; not in the most arid, western ranges. The local distribution seems to be influenced primarily by freezing weather and soil moisture (Bowers 1980–81; Turner 1995). The largest known Arizona specimen (*Malusa 1 Jan 2001*) measured 13 ft in height, with a crown 18 ft wide (Arizona Registry of Big Trees 2005). It has been in mountains in Organ Pipe for at least 3500 years.

Southwestern Arizona southward to the Guaymas Region in Sonora, and both Baja California states.

The sap was famous as arrow poison and widely feared (e.g., Felger & Moser 1985). Chico Suni said it is "poison, it will kill you" (Felger et al. 1992: 27). Medicinal uses include treating sores (Nabhan et al. 1982). The seeds are a favorite food of packrats. This shrub is the host plant for a large native silk moth (*Eupackardia calleta*). The cocoons of this moth have been used by O'odham groups for Yaqui-style *pascola* leg rattles, and the O'odham name for the plant refers to a *pascola* dance step (Chico Suni in Felger et al. 1992). The seeds are sometimes parasitized by moth larvae (*Cydia deshaisiana*) and have been called "Mexican jumping beans." Sometimes sold as curios, these are more likely to be from *Sebastiania pavoniana*, a shrub or small tree in the Álamos region of southeastern Sonora.

OP: Quitobaquito: 30 Jan 1894, *Mearns 2753* (US); 6 Dec 1978, *Hodgson H-209* (DES). Canyon Diablo, 21 Mar 1935, *Peebles 10820*. Pitahaya Canyon, *Nichol 23 Feb 1939*. Alamo Canyon, 3000 ft, 14 Mar 1941, *Benson 10668*. Bates Well, *Tinkham 23 Apr 1942*. Organ Pipe, 2400 ft, S slope, larvae in seeds cause them to move, 23 Aug 1950, *Blakley B-559* (DES). Ajo Mts, small canyon immediately below the arch in Arch Canyon, 900 m, rare, shrub 1.5 m tall, 2 Dec 1990, *Felger 90-515*. †Alamo Canyon, leaf fragments, fruits, seeds, 1150 ybp. †Puerto Blanco Mts, on ridge, leaf fragments, seeds, modern to 3440 ybp (10 samples).

CP: Tule Wells, near Mexican border, small trees about 4 m tall, leaves red or green, 11 Jan 1975, *Booth A-132*. Agua Dulce Mts, Davidson Canyon at Mexican Boundary, 8 Apr 1979, *Lehto L23602* (ASU). O'Neill Hills, 17 Mar 1992, *Yeatts 3255* (CAB). Little Tule Well, 5 Mar 1994, *Felger 94-31*. Charlie Bell Road 3 km NE of Little Tule Well, 1282 ft, "multiple stems, ca. 2.6 m tall and 4 m across, the leaves unusually

large, the plant very leafy and green," 5 Mar 1994, *Felger 94-27* (ARIZ, ASU). Observations: Upper bajada, Sheep Mt, 31 Jan 1992, *Felger*; Eagle Tank, Heart Tank, *Felger*, 13 & 14 Jun 1992. Wash on bajada on SW side of Growler Mts, 1 Jan 2001, *Malusa*, observation (Arizona Registry of Big Trees 2005).

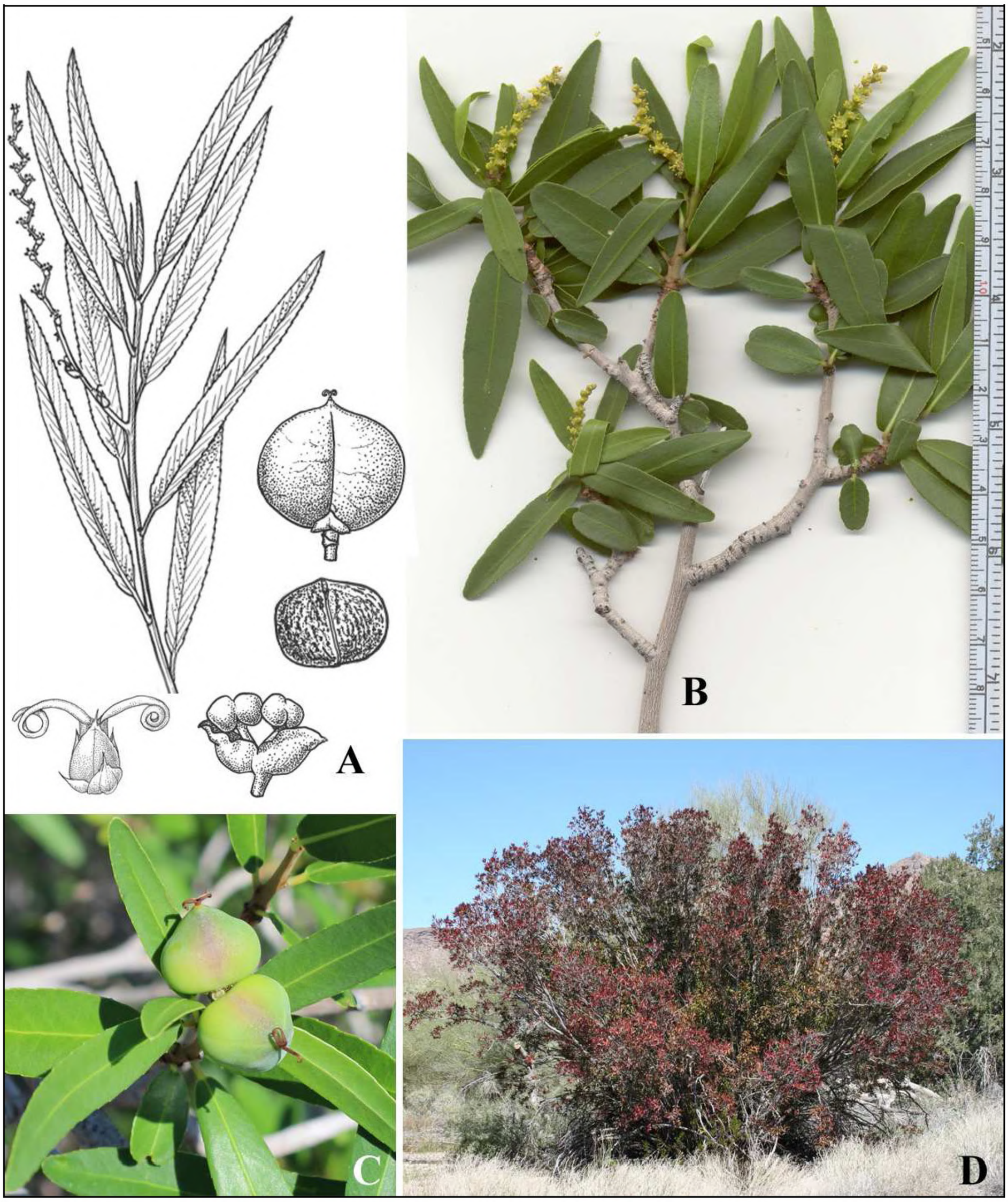

Figure 33. *Pleradenophora bilocularis*. (A) Female flower (left), male flower (right), by Lucretia Breazeale Hamilton. Ajo Scenic Drive, Little Ajo Mts: (B) 28 Jul 2014; (C) pair of fruits, 6 Sep 2013. (D) Winter foliage, Growler Valley near Bates Well Road, 29 Feb 2008.

Stillingia

Mostly herbaceous perennials, rarely annuals (also shrubs or small trees elsewhere). Mostly tropical and dry regions of the Americas, several in Oceania; 30 species.

Three species occur in the Sonoran Desert, two of them in Arizona. *Stillingia spinulosa* Torrey is found in southwestern Arizona, northwestern Sonora, southeastern California, and northeastern Baja California. It occurs near the flora area west of the Tinajas Altas Region and in adjacent northwestern Sonora. The Arizona species can be distinguished as follows:

1. Annuals or more often perennials; leaves alternate, linear, the margins entire or minutely toothed near tip. ..... **Stillingia linearifolia**
1. Spring ephemerals; leaves alternate below, opposite or whorled above, ovate, margins spinose-toothed. ..... **Stillingia spinulosa**

Stillingia linearifolia S. Watson

Queen's root. Figure 34.

Plants glabrous; 10–80 cm tall, annuals flowering in the first season as early as March or more often becoming perennial subshrubs, probably short-lived; quickly forming a deep taproot. Plants including herbage and inflorescences, flowers, and capsules green to bluish-green and/or reddish. Sap milky but thin and watery. Usually with many, mostly erect, slender stems arising from near the base; foliage usually sparse. Leaves alternate, linear, 1.5–5 (7) cm × (0.6) 0.9–2.8 mm, entire to minutely toothed at the tip; stipules 0.4 mm long, represented by stalked glands. Male and female flowers on the same plant. Flowers in slender, terminal or axillary, spike-like racemes 2–7 cm long, with female flowers at the base; flowers small, petals absent. Capsules 3-seeded, the seeds round, 2.6 mm wide. Growing and flowering any time of year with sufficient soil moisture, except during the coldest weeks or months.

Dunes and windblown sands in Cabeza Prieta in the vicinity of the Pinta Sands where the most extensive population occurs, and occasionally elsewhere in the Refuge in sandy soils. The plants sometimes show freeze damage. The one Organ Pipe record seems to be a waif; the locality has been revisited on a number of occasions but no other specimen has been found.

Western Arizona, southern California, southern Nevada, Baja California, northern Baja California Sur, and northwestern Sonora.

OP: Acuña Basin, headwaters of Aguajita Wash, 32°02′30″N, 112°55′W, just N of Puerto Blanco Mts, 19 Mar 1992, *Baker 8787A* (ORPI 14241).

CP: Pinacate Plateau: Open sandy desert, *Gentry 3515* (DES, annuals, reproductive); *Goodding 5 Mar 1940* (ASU). Pinta Sands: *Simmons 16 Mar 1963* (CAB); 780 ft, low dunes, pistillate flower reddish, subtended by red glands, the fruit green with red on carpel-ridges, the staminate flowers red,1 Feb 1992, *Felger 92-32*. 10.3 mi WSW of Papago Well, Camino del Diablo, 12 Mar 1983, *Daniel & Butterwick 2682* (ASU; annuals, reproductive). East Pinta Sands, 15 Sep 1992, *Felger 92-751*. 2 mi NW of Christmas Pass, *Rutman 18 Feb 2002*.

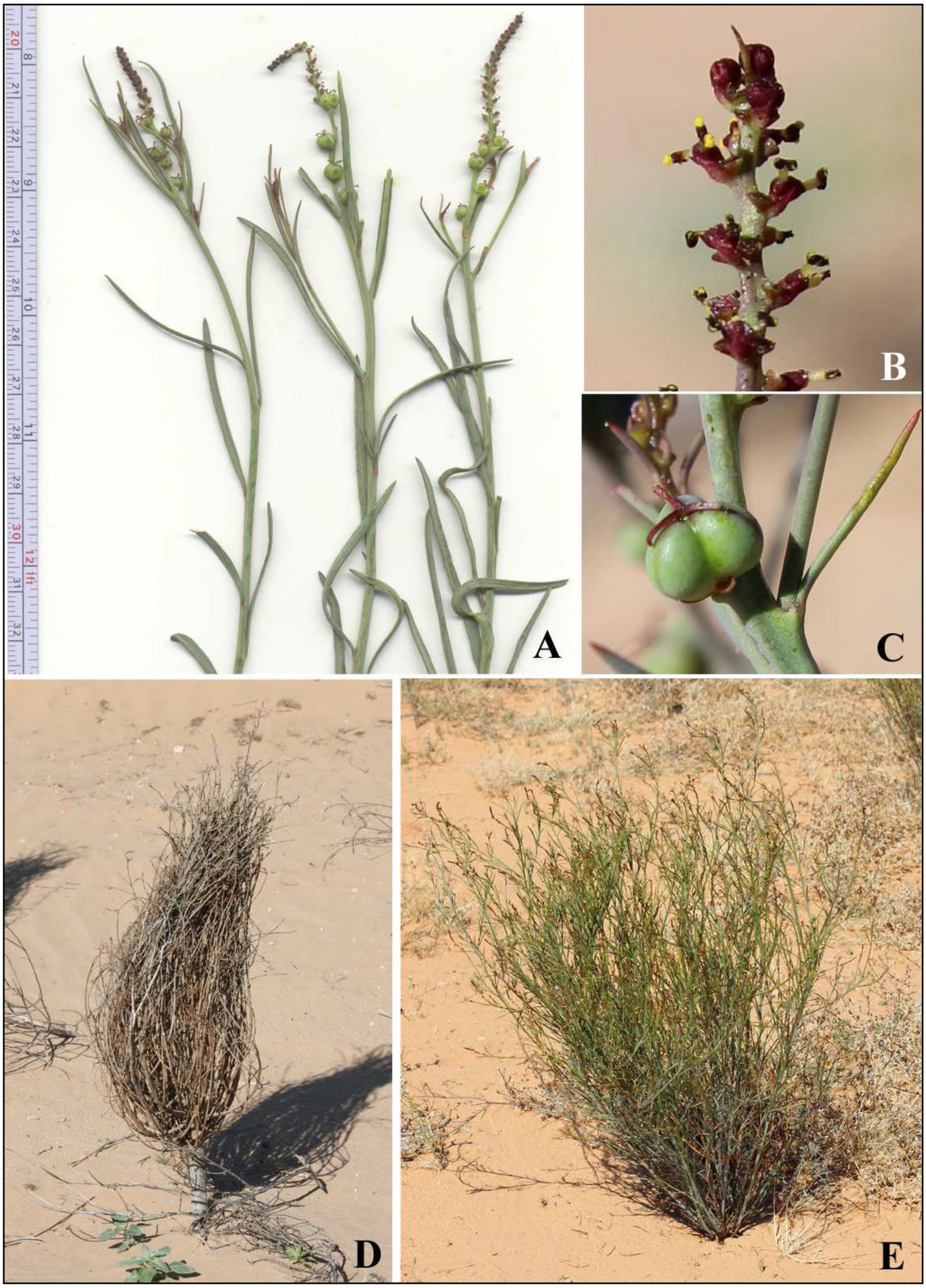

Figure 34. *Stillingia linearifolia*. (A) Pinta Sands, 11 Feb 2014. Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora: (B & C) 15 Feb 2014; (D) 17 Feb 2008. (E) Gran Desierto, Mex Hwy 2, 5 Mar 2014.

Tragia

Nearly worldwide, mostly tropical and subtropical; 175 species.

†**Tragia** sp.

Nose-burn; *ortiguilla*. Figures 35 & 36.

Herbaceous perennials, usually less than 50 cm tall, with stinging hairs; the hairs spreading, relatively long, slender, straight, and silvery; sap essentially absent. Plants green especially when well-watered and growing during hot weather, otherwise generally reddish-green especially in drought or dry seasons and winter. Stems slender and twining. Leaves gradually drought-deciduous, alternate, and petioled; blades often 1–3.5+ cm long, thin, broadly ovate to ovate, triangular-ovate, or lanceolate and mostly cordate at the base; margins coarsely toothed and ciliate with prominent stinging hairs; stipules triangular-lanceolate, green when young, becoming brown, scarious, and relatively persistent. Inflorescences of slender, terminal and axillary racemes 1.5–4.5 cm long including the peduncle: developing from young, growing stem tips, and continuing to develop as the stem elongates and thus appearing axillary (opposite from a leaf). Inflorescences with straight, spreading, silvery hairs throughout, finely glandular, the glands sessile, or some specimens with few sub-stipitate glands only at the inflorescence tips or throughout the inflorescence. Male and female flowers on the same inflorescences, petals none; female flowers solitary, at the base of inflorescences, the stigmas papillate; male flowers above, the pedicel bases persistent. Fruits of capsules, 3-lobed, the crests (midribs of the mericarps, or carpels) with prominent, spreading, silvery-white hairs like a miniature mohawk haircut. Seeds 3 per capsule, nearly globose, 2.5 mm wide; without a caruncle. Reproductive in response to spring and summer-fall rains.

Figure 35. *Tragia* sp. N-facing rocky slope, North Puerto Blanco Mountains, 5 Mar 2015.

Washes, canyons, and rocky slopes, often in shaded or protected habitats in many parts of Organ Pipe except the southwest corner. This or a similar species has been in the Puerto Blanco Mountains at least 3500 years.

Urtecho (1996; in press) reminds us that *Tragia* is a taxonomically difficult genus and that "The *Tragia* situation in SW AZ is complex" (pers. comm. to Felger, 3 Mar 2015). Indeed the

population in southwestern Arizona presents unanswered taxonomic questions and conflicting opinions, and we are in a quandary of what to call it. In our opinion, there is only one species of *Tragia* in Organ Pipe—perhaps it is an undescribed taxon or there is a need for modified interpretation of an existing or proposed taxon. Robert Urtecho (pers. comm. 2–4 Mar 2015) identified at least one Organ Pipe specimen as *T. jonesii* Radcliffe-Smith & Govaerts: The "image (*Pinkava 9978*, US) is of a plant that has both the stipitate glands and twinning habit of *T. jonesii*. This is what was once thought to be *T. amblyodonta*." However, George Ferguson found that the specimen of *Pinkava 9978* at ARIZ is not consistent with *N. jonesii* specimens from Sonora and lacks stipitate glands on the inflorescences. *Tragia jonesii* is distinguished in part by prominent tack-shaped (stipitate) glands at least on the inflorescences and occurs in western Sonora and the Baja California Peninsula. Steinmann and Felger (1997) reported the northernmost record to be from northwestern Sonora (6 mi E of Altar, *Wiggins 5972*, US). In another email, Robert Urtecho shared a "photo from Baja California (SD) of a plant that strongly resembles what you are observing. I call it *T. moranii*. It is not [stipitate] glandular . . . . Please see my dissertation for this description" and further reported, "I have looked over my records and can confirm that plants with leaves that match the size of '*T. moranii*' have been found with stipitate glands. The variability of *Tragia* is the cause of the confusion. Under shaded or moist conditions, leaves can double in size. There is also some variability in the glands present—even within the same population." *Tragia moranii*, however, has not been formerly published and is not known for certain north of Mexico. In his dissertation, Urtecho maps *T. moranii* in Baja California and Baja California Sur, and shows one locality in northwestern Sonora. The Organ Pipe specimens (cited below) show varying similarity with Urtecho's description for *T. moranii*.

Another possibility is aligning Organ Pipe specimens with a broadly interpreted *T. nepetifolia* Cavanilles, although Urtecho (pers. comm. to Felger, 5 Mar 2015) advises that the Organ Pipe specimens do not conform to his concept of *T. nepetifolia*. Urtecho (in press) indicates the United States and western Mexico populations of *T. nepetifolia* "most closely resemble var. *dissecta* Müller Argoviensis, one of four varieties." Urtecho also reports *Tragia nepetifolia* var. *dissecta* has papillate stigmas and "differs from other *Tragia* species in the flora area [United States] in its combination of leaf blades that are often red-tinged with dentate to serrate margins and proximally are broadly ovate to sometimes suborbiculate." He also reports *N. nepetifolia* in the U.S. to be a montane species of "pine-oak woodlands," and thus precluding Sonoran Desert occurrence. However, Steinmann and Felger (1997) report *T. nepetifolia* var. *dissecta* in Sonora occurring in Sonoran Desert, grassland, oak woodland, and pine-oak woodland. Who will follow Robert Urtecho's seminal work? Taxonomy can be intriguing.

OP: Alamo Canyon: 12 Apr 1944, *Clark 11589* (ORPI); 3 December 1977, *Bowers 985* (2 sheets, ARIZ 219423, 219365); *Van Devender 31 Aug 1978*. Puerto Blanco Mts, Dripping Wells, 18 Mar 1945, *Gould 3021*. Dripping Springs, 27 Oct 1951, *Supernaugh 455* (ORPI). Arch Canyon, along East Loop, 28 March 1965, *Niles 537*. 3.3 mi from Rt. 85, peaks encircled by East Loop, 24 Nov 1972, *Pinkava 9978* (ARIZ, ASU, DES, US). 1 mi E of Visitor Center on Ajo Loop Rd, 9 Sep 1984, *Van Devender 84-453*. Growler Canyon, *Wirt 24 Apr 1989* (ORPI). Below arch in Arch Canyon, 2 Dec 1990, *Felger 90-510*. W side and base of Sierra Santa Rosa, 509 m, 12 Mar 2003, *Felger 03-315*. Growler Valley, 8 Oct 2006, *Rutman 20061008-1*. †Puerto Blanco Mts, leaf fragments, capsules, seeds, 980 to 3440 ybp (3 samples).

Figure 36. *Tragia* sp. Alamo Canyon: (A & D) 10 Sep 2008; (E) 26 Mar 2005. (B) Arch Canyon, 16 Sep 2006. (C) Bates Well Road, about 1 mile S of Organ Pipe N boundary, 4 Aug 2014.

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